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Engineering Evaluation of the 618-9 Burial Ground Expedited Response Action

United States
Department of Energy
Richland, Washington

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EXECUTIVE SUMMARY

Throughout Hanford Site history, chemical waste products were disposed via burial in trenches. One such trench was the 618-9 Burial Ground, located in the 600 Area on the Hanford Site. The 618-9 Burial Ground was suspected to contain approximately 5,000 gal (19,000 L) of uranium contaminated solvent in 55-gal (208-L) steel drums.

On December 20, 1990, the U.S. Department of Energy (DOE) was instructed by the U.S. Environmental Protection Agency (EPA) and the State of Washington Department of Ecology (Ecology) to initiate planning necessary to implement an expedited response action (ERA) for the 618-9 Burial Ground. The project was to be implemented in two phases: (1) removal of immediate human health and environmental hazards and (2) remediation of contaminated soil. Subsequently, Phase I of the project was initiated February 15, 1991.

During Phase I activities, completed in May 1991, approximately 700 gal (2,650 L) of methyl isobutyl ketone (hexone) and 900 gal (3,400 L) of kerosene solvent were removed from the 618-9 Burial Ground. In addition to the solvents, a significant amount of scrap process equipment/building debris was excavated. Extensive follow-up sampling has shown that relatively insignificant amounts of kerosene remain, and hexone was not detected. The results of an environmental risk assessment for chemicals above detection further determined that risks posed by other detected constituents to human health and the environment are negligible.

A compilation of activities utilized for determining subsequent remediation activities for the 618-9 Burial Ground is presented. This includes: (1) Phase I activities, (2) sampling performed and associated data results, (3) results of the risk assessment, and (4) applicable or relevant and appropriate requirements.

It is recommended that the following actions occur: (1) Final disposal of the recovered solvent and other waste generated during excavation of the 618-9 Burial Ground; (2) backfill and revegetation of the site, and (3) surveying of the trench boundaries for future reference.

Should the DOE, EPA, and Ecology deem it advantageous to remove the 618-9 Burial Ground from further consideration as an ERA, issuance of a Record of Decision regarding the 618-9 Burial Ground ERA is recommended.

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1.0 INTRODUCTION

Throughout Hanford Site history, prior to legislation regarding disposal of hazardous waste, chemical waste products were disposed via burial in trenches. One such trench was the 618-9 Burial Ground. The 618-9 Burial Ground was suspected to contain approximately 5,000 gal (19,000 L) of uranium contaminated organic solvent derived from laboratory studies in the late 1940's and early 1950's. The solvent was believed to have been contained in 55-gal (208-L) drums; however, the number of drums buried was not well documented.

On December 20, 1990, the U.S. Department of Energy (DOE) was instructed by the U.S. Environmental Protection Agency (EPA) and the State of Washington Department of Ecology (Ecology) to initiate planning necessary to implement an expedited response action (ERA) for the 618-9 Burial Ground. The project was to be implemented in two phases: (1) removal of immediate human health and environmental hazard(s), and (2) remediation of contaminated soil. This document provides the engineering evaluation of Phase I activities and presents recommendations for Phase II activities.

1.1 BACKGROUND

On October 18, 1990, an Agreement in Principle among the DOE, EPA, and Ecology was signed. The agreement stated that, initially, three candidate sites would be considered for ERAs:

- 618-9 Burial Ground
- 300 Area Process Trenches
- 200 West Area carbon tetrachloride plume.

After review of the project plan for the 618-9 Burial Ground by EPA and Ecology, an Action Memorandum was issued on February 15, 1991, initiating time-critical activities for Phase I of the 618-9 Burial Ground ERA.

The ERA for the 618-9 Burial Ground was conducted in accordance with the requirements outlined in the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) (Ecology et al. 1989, Part 3, Article XIII, Section 38) and in accordance with 40 CFR 300, Subpart E. An ERA, also known as an interim response action, is a provision included in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended. This provision allows for ERAs to be taken at waste sites where early remediation will abate potential threats or prevent significant increased degradation that might occur if action were delayed until completion of the Remedial Investigation/Feasibility Study (RI/FS) and subsequent remedial action.

1.2 OBJECTIVE

The objective of this document is two fold: (1) to evaluate the risk remaining to human health and the environment after completion of Phase I activities and (2) recommend subsequent actions. The ERA for the 618-9 Burial Ground is being conducted in support of the RI/FS for the

300-FF-2 operable unit. The RI/FS work plan for the 300-FF-2 operable unit is included in the Tri-Party Agreement; however, specific dates have not been established for initiation of the work plan. Implementation of this ERA does not represent a final remediation of areas contained within the 300-FF-2 operable unit; however, the ERA does complement and is consistent with final remediation of the site. The ERA for the 618-9 Burial Ground was specifically undertaken to alleviate the immediate hazards of potentially leaking drums.

1.3 NATIONAL ENVIRONMENTAL POLICY ACT

Implementation of the ERA for the 618-9 Burial Ground has been and will continue to be conducted in accordance with the National Environmental Policy Act (NEPA) of 1969, and the regulations of the Council on Environmental Quality, 40 CFR 1500-1508. A categorical exclusion was approved for all activities identified within Phase I of the project, as well as stabilization activities that may be needed to ensure the integrity of the 618-9 Burial Ground (as a part of Phase I). An Action Description Memorandum was recently approved by DOE-Headquarters that recommended an environmental assessment be performed for Phase II activities. Should future negotiations determine the continuation of Phase II activities are not necessary, the level and type of additional NEPA documentation may need to be reevaluated.

1.4 LOCATION AND PHYSICAL DESCRIPTION OF THE 618-9 BURIAL GROUND

1.4.1 Site Location

The 618-9 Burial Ground is located on the Hanford Site, approximately 1 mi (1.6 km) west of the Columbia River, and a few miles north of Richland, Washington (Figure 1-1). The Hanford Site is operated by the Westinghouse Hanford Company (Westinghouse Hanford) for the DOE. The Hanford Site lies within the Columbia Basin, which includes the cities of Pasco, Kennewick, Richland, and the surrounding agricultural inhabitants. In 1987 the total estimated population of the three cities was 102,210.

1.4.2 Site Description

The 618-9 Burial Ground is an 185-ft (58-m) long trench centrally situated within a fenced area. It is 10 to 15 ft (3 to 4.5 m) deep, 18 ft (5.5 m) wide at the bottom, and has been excavated to a 40 ft (12 m) width across the top. The 618-9 Burial Ground lies on a relatively level portion of the Hanford Site at an elevation of 380 to 410 ft (116 to 125 m). The soil consists of gravel and fine sand. There are no wetlands in the vicinity of the 618-9 Burial Ground and the climate is semiarid. The average monthly temperature ranges from -1.5°C in January to 24.7°C in July. The annual average relative humidity is 54%. Average annual precipitation is 6.3 in. (16 cm).

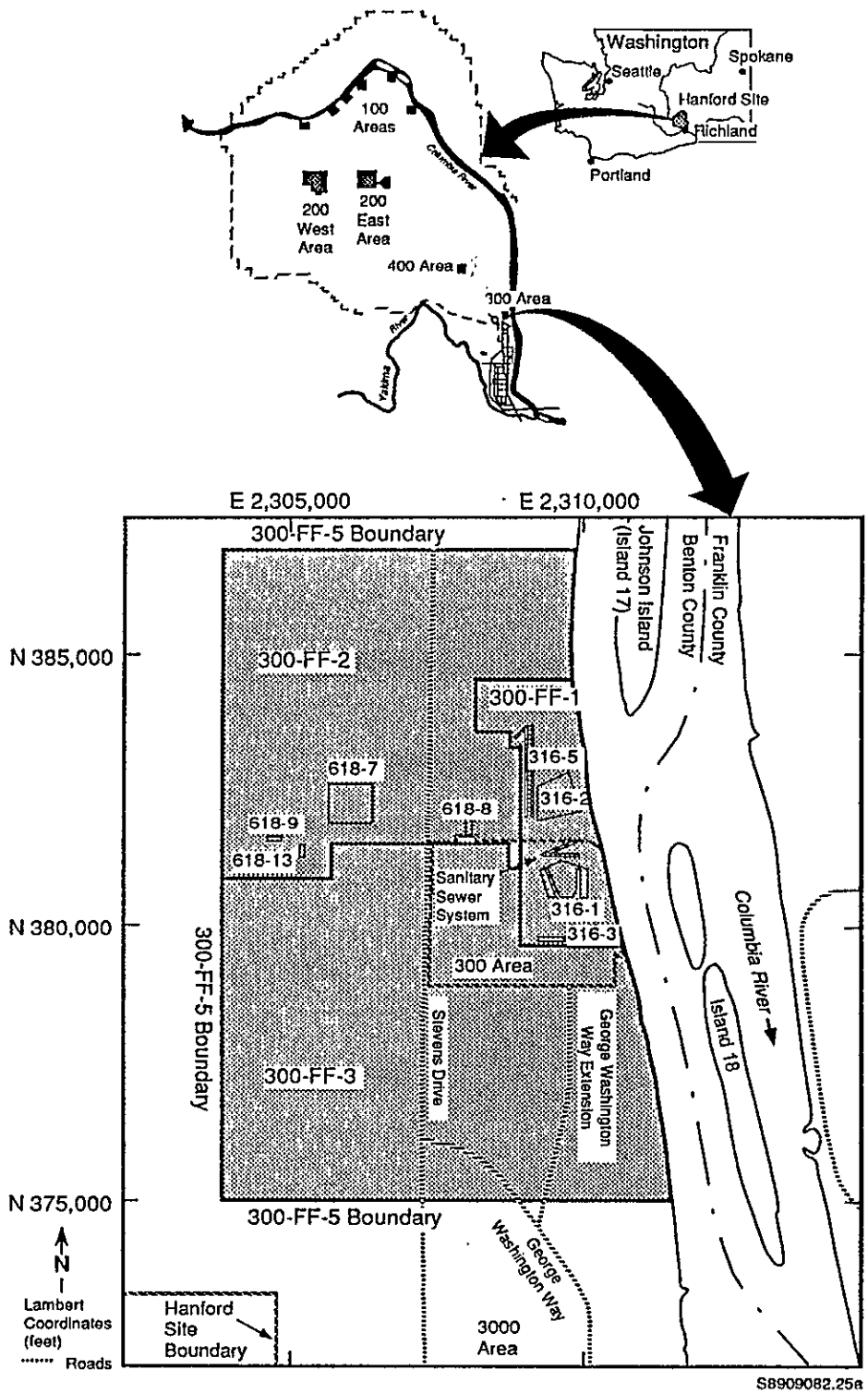

Figure 1-1. Location of 618-9 Burial Ground.

2.0 PHASE I PROJECT ACTIVITIES

As discussed in Section 1.0, the ERA for the 618-9 Burial Ground was divided into two phases: (1) time critical removal activities associated with removing the immediate human health and environmental hazard(s), and (2) remediation of contaminated soil. Activities associated with implementation of Phase I of the project are discussed in the following sections.

2.1 PRELIMINARY INVESTIGATION

Prior to implementation of Phase I removal activities, a preliminary investigation was performed. The purpose of this investigation was to gather information that would assist in identification of hazards and contents of the 618-9 Burial Ground. Activities conducted during the preliminary investigation were: (1) historical research, (2) interviews with personnel employed during years waste was disposed in the 618-9 Burial Ground, (3) a geophysical survey, (4) a soil gas survey, and (4) evaluating existing groundwater monitoring data and information compiled in the Waste Information Database System (WIDS).

2.1.1 Historical Information

Historical waste disposal information was obtained from the WIDS (Appendix A) and a few other documents. The WIDS is the official waste disposal database for the Hanford Site. Historical records indicated that the facility was operational in the early 1950's, and received 5,000 gal (19,000 L) of uranium contaminated solvent, most likely hexone [methyl isobutyl ketone (MIBK)]. A specific closure date was not listed.

2.1.2 Interviews

Interviews with personnel employed at the facility during the 1950's provided additional information regarding the items disposed in the 618-9 Burial Ground. It was suggested that chemicals other than MIBK, such as kerosene/tributyl phosphate were also buried, and that tanks, and other items were disposed therein. In reference to uranium in the solvents, it was suggested that the solvents may have been distilled prior to disposal for uranium recovery, and that the uranium would not have been discarded as waste.

2.1.3 Geophysical Survey

A geophysical survey was conducted to verify historical information regarding disposal in the 618-9 Burial Ground, and to define burial ground boundaries. Results of the survey confirmed anomalies occurring at approximately 4 ft (1.2 m) below ground. Since this depth was as described in historical documentation, drums were thought to be covered with 4 ft (1.2 m) of overburden. The results of the geophysical survey have been published in Geophysical Surveys at the 618-9 Burial Ground (WHC 1991a).

2.1.4 Soil Gas Survey

A soil gas survey was conducted to detect the presence of MIBK and other volatile organic carbons (VOCs) at the 618-9 Burial Ground. A total of 24 soil gas samples were collected and qualitatively analyzed via a gas chromatograph. Five common organic compounds were used as standards in the gas chromatograph: benzene, toluene, ethylbenzene, M-xylene, and O-xylene. Of the 24 samples collected, 16 identified the presence of unknown VOCs. The unknown VOCs were observed in the eastern half of the 618-9 Burial Ground.

The retention times of the unknowns did not match the standards used in calibrating the gas chromatograph. Because toluene exhibited the closest retention time, the unknown data was converted to toluene equivalence for comparative purposes only. The maximum toluene concentration exhibited was 1.95 ppm. Appendix B contains a summary of the samples collected and associated data.

2.1.5 Groundwater Monitoring Data

A search through existing groundwater data was conducted to determine whether or not the solvents in the 618-9 Burial Ground had leaked and reached groundwater. Groundwater data has been gathered from wells roughly downgradient of the 618-9 Burial Ground since the early 1960's. Groundwater monitoring data collected during 1989 and 1990 indicated the presence of total organic halogens. Samples collected between 1985 and 1988 indicated the following volatile organic constituents: 1,1,1-trichloroethane, methylene chloride, perchloroethylene, and total organic halogen. For many of the wells, samples were collected monthly, however, the above specified organics were only detected intermittently. Due to insufficient data and the fact that there are numerous other waste disposal sites located near the 618-9 Burial Ground, the origin of these constituents can not be conclusively determined. Additionally, no direct upgradient wells exist to compare downgradient results. The groundwater data was not sufficient to say if the solvents buried were leaking.

Results of recent uranium analyses indicate the concentration of uranium increases downgradient of the 618-9 Burial Ground. This increase in concentration has been attributed to the uranium plumes centered around the 300 Area Process Trenches and the South Process Ponds. Further information regarding historical groundwater data can be found in Appendix C.

2.1.6 Summary of Preliminary Investigations

The preliminary investigations provided the data necessary to initiate excavation. The trench boundaries had been delineated by geophysics, and as a result, it was known that buried objects would be found approximately 4 ft (1.2 m) below ground. Organic vapors were suspected as a potential safety concern, since the soil gas survey indicated the presence of some unidentified organic vapors. Historical information and personnel interviews provided the information necessary to prepare the required safety and emergency planning documentation. Documentation prepared prior to excavation activities discussed the potential to uncover a variety of organic solvents and a large quantity of uranium.

2.2 EXCAVATION ACTIVITIES

2.2.1 Techniques

Excavation of the 618-9 Burial Ground commenced on February 28, 1991. Digging originated at the center of the trench over areas showing anomalies in the geophysical survey. To avoid breaching the drums, soil was machine excavated, leaving 1 to 2 ft (.3 to .6 m) of overburden. Hand digging was performed on the remaining soil.

The initial excavation uncovered a variety of debris covered by 4 ft (1.2 m) of backfill. The debris included among other items, empty waste drums, a wheel barrow, construction debris (corrugated siding, process vessels, and piping), 2 bags ammonium nitrate fertilizer (breached), unidentified white powders, and several lead bricks.

All drums were found to be located in the east and west ends of the 618-9 Burial Ground, covered by 10 ft (3 m) of overburden (6 ft [1.8 m] deeper than expected). The 120 drums in the western end of the trench were fairly well preserved, and approximately 1,600 gal of solvents were recovered. Although extreme caution was observed throughout excavation activities, one drum was breached, causing a leak of approximately 1 to 2 gal (3.8 to 7.6 L) of a kerosene-like material. This drum had been sitting on its side, 1 to 2 ft (.3 to .6 m) higher than the other drums in the 618-9 Burial Ground. The spill was cleaned up and the contaminated soil was contained for disposal. Drums in the eastern end were severely corroded and only parts of the drums remained. The number of drums could not be counted due to their condition. Figure 2-1 depicts the three sections of the 618-9 Burial Ground. Figure 2-2 depicts a section through the west end (Section 1 of trench), roughly to scale. The first drums encountered were upright, as shown. As excavation moved west, more drums were uncovered, which were on their sides.

A nonsparking spike, welded to the backhoe bucket, was used to remotely punch a hole through each drum. If liquid was found, it was tested with a field test kit and subsequently pumped into a new drum. Preliminary field sampling (see Section 2.3.2) was used to determine liquid compatibility and to test for peroxides.

The debris exhibited very little signs of contamination as determined by field instrumentation; however, Westinghouse Hanford policy is to not release potentially contaminated material that can not be thoroughly surveyed with field instruments. For this reason, most of the debris was placed in burial boxes for disposal in the low-level burial ground.

Recovered solvents are currently stored onsite in 55-gal (208-L) steel drums, packed in 85-gal (322-L) steel overpack drums. The drums are set on pallets with 2-ft (.6-m) spacing between rows. The drums are inspected weekly.

2.2.2 Ambient Air Monitoring

Environmental and personal air monitoring was conducted throughout implementation of Phase I activities. Nonradioactive monitoring was conducted via standard personal monitoring equipment (BDX 44 Monitor, a trademark of Sensidyne). Contaminants were collected on an activated charcoal media at flow rates between 10 and 200 ml/min, depending upon personnel and site conditions.

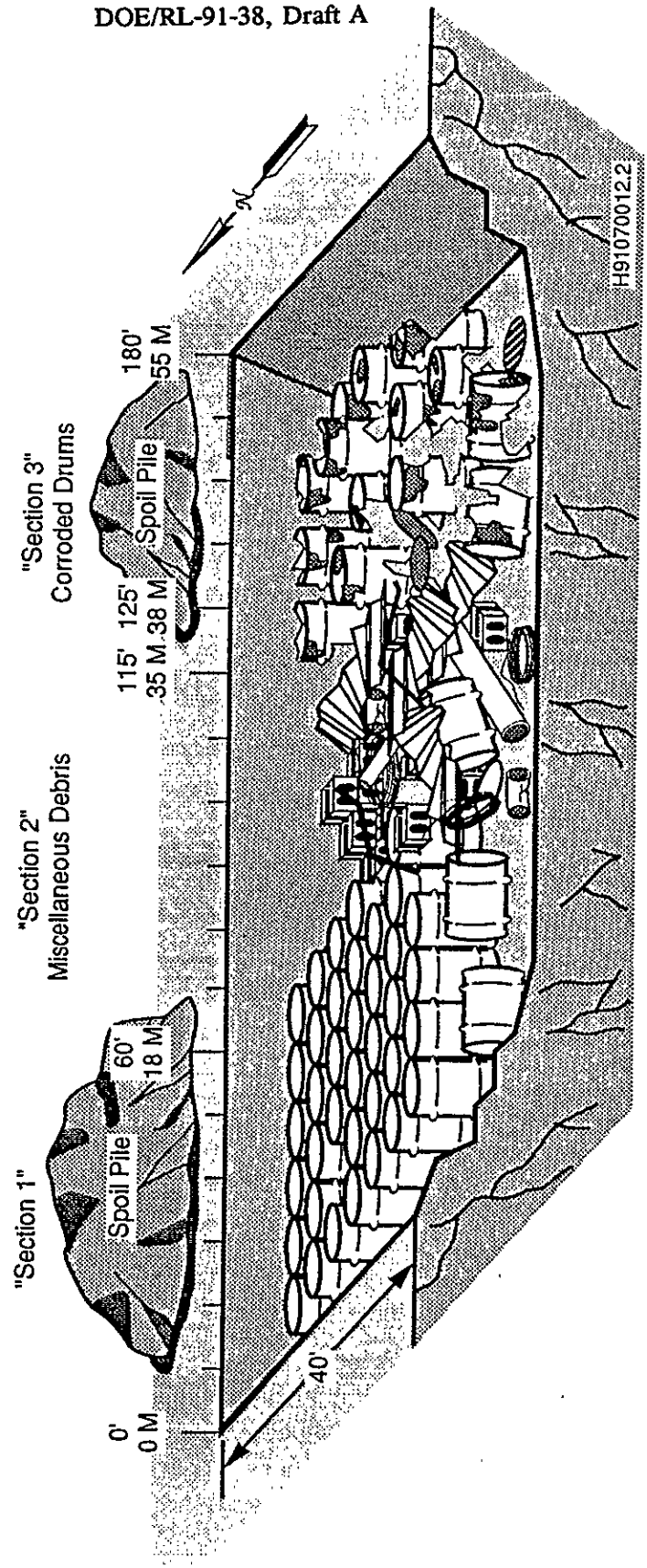

Figure 2-1. Waste Disposal Sections of the 618-9 Burial Ground.

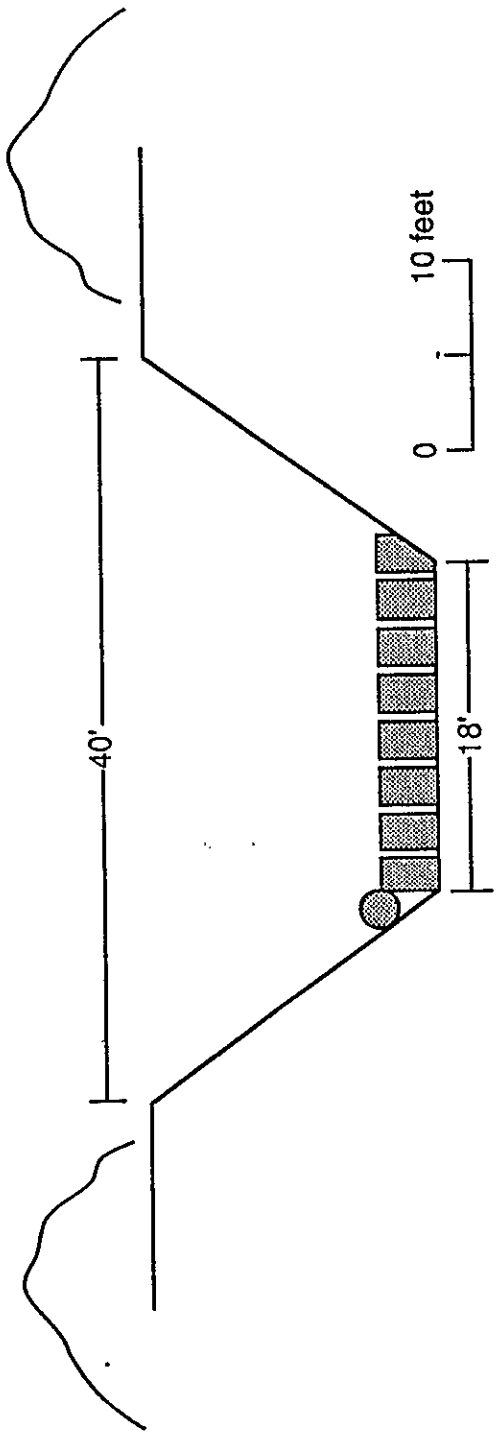

Figure 2-2. Section of Drums Found in Section 1 of the 618-9 Burial Ground.

The maximum concentrations of carbon tetrachloride, MIBK, and kerosene present during nonradiological monitoring activities were <0.08 ppm, 0.22 ppm, and <5 mg/m^3, respectively. All readings were below limits set for personnel exposure and do not pose threats to the public. Tables presenting the results of the environmental air monitoring are included in Appendix D.

Radioactive monitoring was conducted via continuous air monitors. Samples were collected on high-efficiency glass filters at a flow rate of 2.6 m^3/hr. Results of the radiological air samples received to date (total alpha and total beta) indicated levels at or near background, and did not increase as a result of field activities. Results for uranium, plutonium, gamma energy analysis, and strontium have not been received from the offsite laboratory. The results will be appended upon receipt.

2.2.3 Results of Excavation Activities

Approximately 1,600 gal of solvent and over 1,400 ft^3 (40 m^3) of debris were removed from the 618-9 Burial Ground. The removal of material set the stage for the sampling activities designed to determine the nature of contamination in the 618-9 Burial Ground.

2.3 SAMPLING ACTIVITIES

Sampling of recovered liquids, potentially contaminated soil, and other miscellaneous waste items recovered from the 618-9 Burial Ground (i.e., unknown white powder) was conducted to determine the nature of contamination and to assist in proper waste disposal. Sampling activities were organized into the following categories: (1) preliminary solvent sampling, (2) recovered solvent sampling, (3) miscellaneous waste sampling, and (4) soil sampling. Each of these categories are further discussed in the following sections.

2.3.1 Preliminary Solvent Sampling

Preliminary sampling, using the Haztech Hazcat kit (a trademark of Sensidyne), provided a preliminary designation of chemical compounds and their compatibility with other materials found in the 618-9 Burial Ground. This information was used to develop an estimate of the volume of MIBK and/or kerosene in the 618-9 Burial Ground and to calculate a conservative estimate of the volume that could have leaked. In addition, the information was useful in properly segregating and storing the wastes prior to permanent disposal.

2.3.2 Recovered Solvent Sampling

The recovered solvent was primarily sampled for waste designation purposes. Sampling activities were conducted in accordance with the 618-9 Burial Ground Interim Response Action, Phase I Sampling and Analysis Plan (WHC 1991b). The recovered solvent sampling was conducted by removing solvents from the 55-gal (208-L) drum using a decontaminated Composite Liquid Waste Sampler (COLIWASA) sampling tube. The samples were analyzed for organics (volatile and semivolatile), inorganic anions, metals, flashpoint, total and isotopic uranium, gamma scan, total alpha and total beta. Preliminary evaluation of the recovered solvents indicated that the solvents were

either MIBK or normal paraffin hydrocarbon (NPH)/tributylphosphate. Radioactivity levels were at or near the detection limit.

2.3.3 Miscellaneous Sampling

Other miscellaneous items were discovered during excavation of the liquid waste. These items included white powder, and suspected ammonium nitrate waste (i.e., fertilizer). Analysis of this material was performed according to Test Methods for Evaluating Solid Wastes (EPA 1986). Samples were collected by driving a decontaminated metal tube through the material to obtain a representative sample. These samples were analyzed for constituents that were suspected as potential contaminants. The sample results are pending and will be appended upon receipt.

2.3.4 Soil Sampling

Thirty-three soil samples were taken from three different sections of the 618-9 Burial Ground and the excavated soils. Three strata were sampled:

- Loose soil that surrounded the drums and debris
- Soil 12 in. (30.5 cm) below the trench bottom
- Soil 4 ft (1.2 m) below the trench bottom.

The latter samples were obtained by sampling soil from the backhoe bucket. Sampling locations in each section of the 618-9 Burial Ground were chosen using a random number generator to select locations on a grid with 3-ft (1-m) spacing. All sampling was conducted using contract laboratory program protocol, as described in 618-9 Burial Ground Expedited Response Action Soil Sampling Plan (WHC 1991c). Figure 2-3 depicts the locations of the soil samples.

Analyses were selected to detect constituents suspected to reside in the soils in the 618-9 Burial Ground. These were chosen from the historical information, interviews, and from the items discovered during excavations.

The suspected constituents were:

- MIBK (suspected buried solvent)
- Kerosene mixed with tri-butyl phosphate (suspected buried solvent)
- Ammonium nitrate (breached bag found in trench)
- Metals (from debris in trench)
- Uranium (suspected to have been contained with the solvents).

To detect these constituents, the samples were analyzed for organics (semi- and volatile), metals, anions, total alpha, total beta, gamma scan, total uranium (if > detect, isotopic U). A complete summary of the soil analyses results can be found in Appendix E.

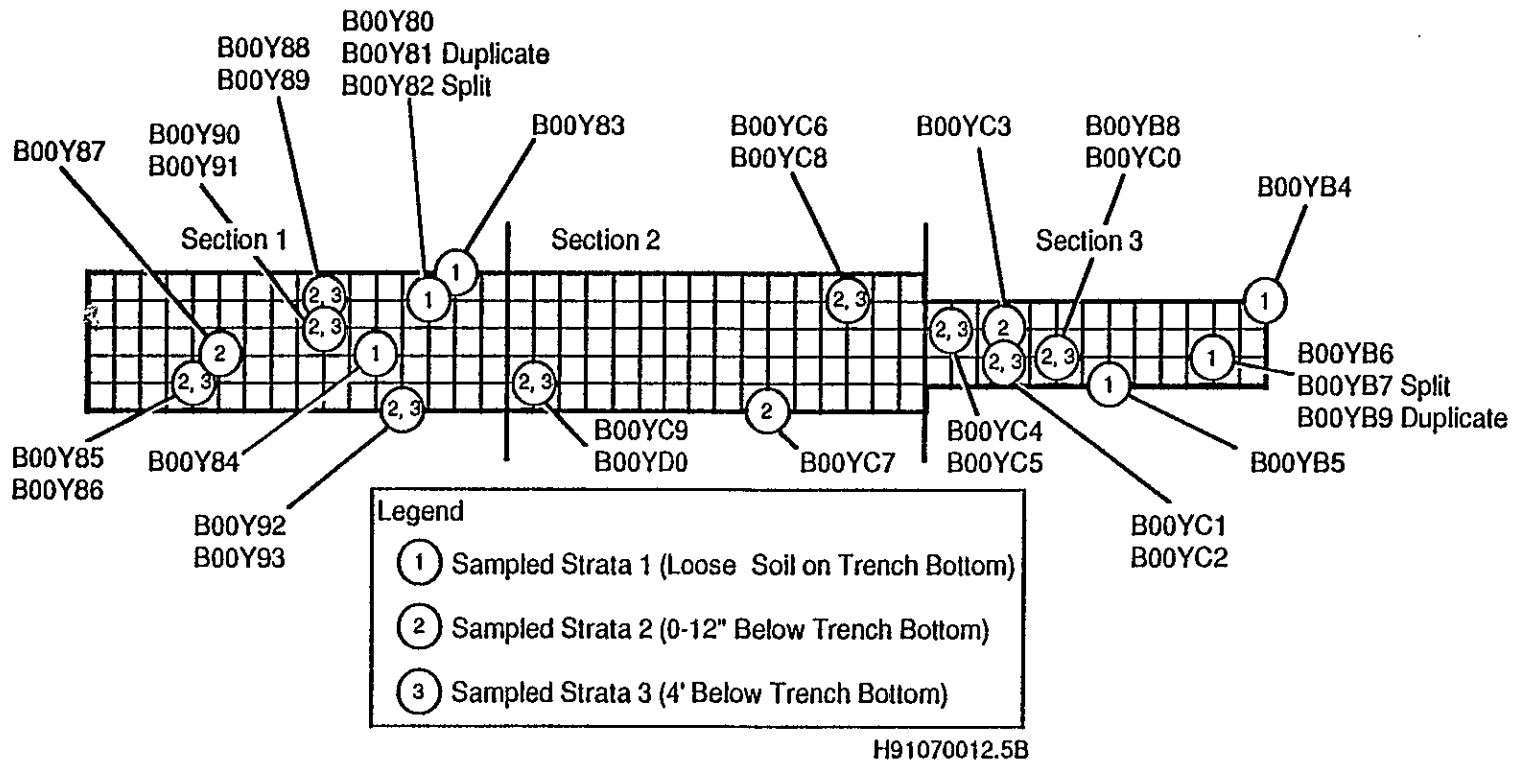

Figure 2-3. Soil Sampling Locations.

3.0 DATA ASSESSMENT

The data assessment section provides an evaluation of analytical data from soil samples, discusses the fate of MIBK, and summarizes constituents of concern. The data from the sample analyses has been summarized in Table 3-1 and is presented in its entirety in Appendix E.

3.1 DATA EVALUATION

An evaluation of the sampling data was performed to identify constituents of concern. This evaluation included: (1) a statistical evaluation, (2) a comparison of the data with background data, (3) a comparison of the data with the blanks, (4) tentatively identified compounds, (5) outlying data, and (6) an evaluation of constituents expected from historical data. These evaluations are discussed in the following sections.

Note that all chemicals that had at least one positive detection were evaluated further. Results of the evaluation provided the basis for the risk assessment and chemicals of concern for comparing with applicable or relevant and appropriate requirements (ARARs).

To date, radiological data analyses are not complete. Field readings and total activity scans conducted to ship the samples offsite did not indicate the presence of any radiological constituents. It is not expected that laboratory data will identify radiological problems at the site. This information will be appended upon receipt.

3.1.1 Statistical Evaluation

For the chemicals under evaluation, the frequency of detection, arithmetic mean, standard deviation, upper 95% concentration, and range of concentrations were determined (Table 3-1). If a chemical was not detected in a particular sample, it was assumed to be present at one half the sample quantification limit unless the sample quantification limit was unreasonable (higher than the minimum contract lab required detection limit), in which case the sample was omitted from the sample population.

3.1.2 Comparison with Background Data

Site-specific background values were available for some metals and anions (DOE 1990). Some of these values were randomly chosen for comparison with values from the U.S. Geological Survey's Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States (Shacklette and Boerngen, 1984) to provide greater certainty that the site-specific background values actually represent levels uncontaminated by the site. For cobalt and silver, background soil data were taken from Boerngen and Shacklette (1981). The upper 95% concentration for each chemical was compared with the average background concentration. If the upper 95% value for a chemical was less than the mean background concentration, the chemical was omitted from further consideration (EPA 1989).

Table 3-1. Evaluation of Chemicals of Potential Concern. (sheet 1 of 3)

Chemical	Frequency of detection[a]	Highest blank (mg/kg)	Average background concentration (mg/kg)	On-site concentrations in soil (mg/kg)			Chemical of concern?	Reason
				Range (including non-detects at detection limit)	Arithmetic mean	Arithmetic upper 95%		
Inorganics								
Aluminum	32/32	181.4	9,690	1,400 - 4,480	2,779.94	3,081.98	NO	Below background
Barium	32/32	24.4	93	21 - 88.1	51.3	56.9	NO	Below background; Max. conc. < 5 X highest blank
Beryllium	23/32	NA	0.4	<0.159 - 0.45	0.21	0.25	NO	Below background
Calcium	32/32	133.3	7,010	2,260 - 5,710	3,397.08	3,648.13	NO	Below background
Chromium	1/32	NA	9.7	<0.42 - 0.47	0.27	0.29	NO	Below background
Cobalt	32/32	NA	17 (7-30) West WA	3.6 - 12.3	6.0	6.61	NO	Below Western WA normal background
Copper	32/32	1.4	1.4	5.1 - 14.1	8.49	9.22	NO	Below background
Iron	32/32	755.1	27,300	7,920.2 - 20,400	11,038.66	11,970.71	NO	Below background
Lead	33/32	NA	5	1.2 - 7.7	2.66	5.0	NO	Below background
Magnesium	32/32	57.4	6,090	1,150 - 4,210	2,239.12	2,457.38	NO	Below background
Manganese	32/32	82.7	391	81.8 - 313	189.23	212.1	NO	Below background; max. conc. < 5 X highest blank
Mercury	8/32	NA	.1	<.1 - .51	.10	.12	NO	At background/below regulatory concern
Nickel	32/32	NA	7.5	2.3 - 9.1	5.48	6.15	NO	Below background
Potassium	31/32	NA	1,590	<176 - 1,411.9	665.13	783.23	NO	Below background
Silver	19/32	NA	2.8 (0.7 - 5) US	<0.566 - 3.1	1.04	1.31	NO	Below typical US background
Sodium	32/32	26.5	287	67.4 - 201	109.98	121.66	NO	Below background

Table 3-1. Evaluation of Chemicals of Potential Concern. (sheet 2 of 3)

Chemical	Frequency of detection[a]	Highest blank (mg/kg)	Average background concentration (mg/kg)	On-site concentrations in soil (mg/kg)			Chemical of concern?	Reason
				Range (including non-detects at detection limit)	Arithmetic mean	Arithmetic upper 95%		
Vanadium	32/32	1.5	59.6	1.9 - 29.8	12.82	14.82	NO	Below background
Zinc	32/32	3	49.5	10.7 - 66.9	24.98	29.67	NO	Below background
Nitrates	23/32	NA	0.6	<1.3 - 1,670	130.94	265.71	YES	Above background; common in diet, but toxic potential is sufficient to warrant further consideration
Organics								
Acetone	30/30	2.5	NA	0.017 - 0.68	0.0777	0.126	NO	Common lab chemical; max. sample concentration < 10 X max. conc. in blank
Bis(2-ethylhexyl)phthalate	4/8	NA	ND	0.037 - 5.2	0.75	2.16	YES	Positive detect with no reason for exclusion
Di-n-butylphthalate	32/32	0.64	NA	0.051 - 6.2	2.31	2.94	NO	Max. sample concentration < 10 X max. conc. in blanks
Butylbenzylphthalate	9/13	NA	ND	0.038 - 2.7	0.732	1.26	YES	Positive detect with no reason for exclusion
Chloroform	2/18	NA	NA	<0.005 - 0.009	0.00306	.00388	YES	Positive detect with no reason for exclusion
Methylene Chloride	31/31	1.2	ND	0.019 - 2.3	0.162	0.322	NO	Common lab chemical; max. concentration in samples < 10 X Max. conc. in blanks
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0/32	NA	NA	0.01 - 1.3[b]	0.138[b]	0.272[b]	YES[b]	Historical data indicates MIBK should be present.
Phenanthrene	1/5	NA	NA	0.24 - <0.33	0.18	0.217	YES	Positive detect with no reason for exclusion

Table 3-1. Evaluation of Chemicals of Potential Concern. (sheet 3 of 3)

Chemical	Frequency of detection[a]	Highest blank (mg/kg)	Average background concentration (mg/kg)	On-site concentrations in soil (mg/kg)			Chemical of concern?	Reason
				Range (including non-detects at detection limit)	Arithmetic mean	Arithmetic upper 95%		
1,1,2,2-Tetrachloroethane	6/20	NA	NA	0.001 - 0.11	0.0156	0.0294	YES	Positive detect with no reason for exclusion
Trichloroethene	1/16	NA	ND	0.002 - < 0.005	0.00247	0.00253	YES	Positive detect with no reason for exclusion
Tetrachloroethene	9/23	NA	ND	0.004 - 0.92	0.0719	0.156	YES	Positive detect with no reason for exclusion
Toluene	2/16	0.002	ND	0.001 - <0.005	0.00238	0.00257	NO	Max. conc. < 5 X highest blank
Tributylphosphate	TIC-16/32[c]	NA	NA	0 - 2,000	125.73	735.25	NO	Only tentatively identified
Kerosene (NPH)	TIC-15/32[c]	NA	NA	0 - 650	64.4	317.9	NO	Only tentatively identified
Hexachloroethane	6/10	NA	NA	0.11 - 17	2.3	5.81	YES	Positive detect with no reason for exclusion
Hexachlorobutadiene	7/11	NA	NA	0.12 - 0.76	0.295	0.295	YES	Positive detect with no reason for exclusion

[a] Non-detects were not considered when detection limits were unreasonably high (above contract lab requirements).
[b] Highest Sample Quantification Limit used for MIBK since no MIBK was detected in the samples, but historical information indicates the likelihood of MIBK contamination.
[c] Tentatively identified compounds included for information only.
NA = Not Available ND = Not Detected

On the basis of comparison to background data, all of the metals (aluminum, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, silver, sodium, vanadium, and zinc) were omitted from further consideration.

3.1.3 Comparison with Blanks

Because contamination of samples with common laboratory chemicals is inevitable, EPA (1989 and 1990a) has developed guidance for determining if such chemicals are from the media sampled or are a result of contamination by sample collection and laboratory procedures. The guidance states that common laboratory chemicals found in a sample should be omitted from consideration as chemicals of concern if none of the positive detections for the samples exceed the maximum concentration in laboratory blanks by ten-fold. Similarly, according to EPA guidance (1989 and 1990a), data for other chemicals should be omitted unless the highest concentration exceeds by five fold the concentration in the highest blank (see Table 3-2). Laboratory blanks are "clean samples" run through the laboratory equipment. These samples may indicate the presence of sample contamination introduced at the laboratory. Blank data were available for acetone, methylene chloride, di-n-butylphthalate, toluene, and several metals. On the basis of comparison with the blank data, acetone, methylene chloride, di-n-butylphthalate, barium, manganese, and toluene were eliminated from further evaluation. Although bis(2-ethyhexyl)phalate was not detected in the blanks, it is a common laboratory contaminant and was detected only four times in the analytical data. As a result, the contaminant was not evaluated further.

3.1.4 Tentatively Identified Compounds

A number of TICs were identified during the analyses for organics in soil samples. These compounds could not be evaluated in the risk assessment, yet have been presented in Appendix E. The two most frequently identified TICs are suspected to be tributyl phosphate and kerosene. Tributyl phosphate is not found in either the Integrated Risk Information System Database (IRIS) or Health Effects Assessment Summary Tables (HEAST) (EPA 1991), and it is not considered a contaminant of concern. While kerosene is the term commonly used for this compound on the Hanford Site, it is actually a purified derivative of kerosene, containing straight chain hydrocarbons in the range of $C_{10}H_{22}$ through $C_{18}H_{38}$. Another term for this compound is NPH. The NPH was tentatively identified at values below 200 ppm in less than half the locations sampled; only two of these locations, in the east end of the trench, exhibited values ranging from 200 to 650 ppm.

Table 3-2. Evaluation of Laboratory Contaminant.

Chemical	Maximum Blank (mg/kg)	10 X Maximum Blank (mg/kg)	Maximum Sample Concentration[a] (mg/kg)	Exclude?
Common Contaminant				
Acetone	0.064 (low)[a]	0.64 (low)	0.28 (low)	YES
	2.5 (med)[a]	25 (med)	0.68 (med)	
Methylene Chloride	0.048 (low)[a]	0.48 (low)	0.24 (low)	YES
	1.2 (med)[a]	12 (med)	2.3 (med)	
Di-n-butylphthalate	0.64	6.4	6.2	YES
Other Chemicals		5 X Maximum Blank		
Aluminum	181.4	907	4480	NO
Barium	24.4	122	88.1	YES
Calcium	133.3	666.5	5710	NO
Copper	1.4	7.0	14.1	NO
Iron	755.1	3775.5	20,400	NO
Magnesium	57.4	287	4210	NO
Manganese	82.7	413.5	313	YES
Potassium	226.3	1131.5	1411.9	NO
Sodium	26.5	132.5	201	NO
Zinc	3	15	66.9	NO
Toluene	0.002	0.01	0.001; <0.005	YES

[a] Low and medium refer to differences in analytical methods (specifically, to differences in the size of soil sample analyzed and the dilution factor). The medium level method has a higher dilution factor with respect to the sample but equal potential after dilution for contamination. Hence, the amount of contamination in relation to the amount of sample is greater for the medium level method.

3.1.5 Outlier Data

Pesticides were not considered to be constituents of concern, and as such, the laboratories were not requested to perform pesticide analyses. There is no historical data suggesting the presence of pesticides in the 618-9 Burial Ground. Since the potential for polychlorinated biphenyl (PCB) contamination existed (buried electrical equipment), all samples were analyzed for PCBs. The split laboratory combines the PCB and pesticides analyses.

Of the two split samples analyzed, aldrin, gamma-chlordane, and heptachlor epoxide were detected in one sample, and no pesticides were detected in the other sample. The levels found were:

- Aldrin, 740 ppb
- Gamma-chlordane, 53 ppb
- Hepatachor epoxide, 42 ppb.

Due to the scarcity of this data, it cannot be evaluated further without historical research, and potentially reanalyzing for pesticides in the other samples.

3.1.6 Evaluation of Historical Data

Historical evidence indicated that MIBK might be present in the subsurface soil. However, analysis of soil samples indicated that no MIBK was present at the depths which soil samples were obtained. EPA guidance (EPA 1989) suggests that in such cases the chemical should be considered to be potentially present at the highest sample quantification limit. This assumption was further utilized while performing the risk assessment.

Since MIBK was detected in the recovered solvents, computer modeling (Section 3.2) was performed to determine the possible fate of MIBK in the soil.

3.2 FATE OF HEXONE

Methyl Isobutyl Ketone (MIBK), also known as hexone, was the primary solvent listed in historical records as having been disposed at the 618-9 Burial Ground. During excavation activities, the solvent was recovered in liquid form, but was not detected in the soil samples.

Figure 3-1 depicts the drum arrangement in Section 1 of the trench, as first discovered in the 618-9 Burial Ground. This layout was used to estimate a volume of MIBK that could have leaked from the 618-9 Burial Ground. The following assumptions were used for developing the estimate: (1) all empty drums between 2 and 94 had been full, and (2) all contained MIBK. Based on these assumptions, it was calculated that 4,360 gal (16,500 L) of MIBK could have leaked. Drums 2 through 94 were assumed to contain MIBK because the recovered solvents found in this area of the trench indicated positive as ketones.

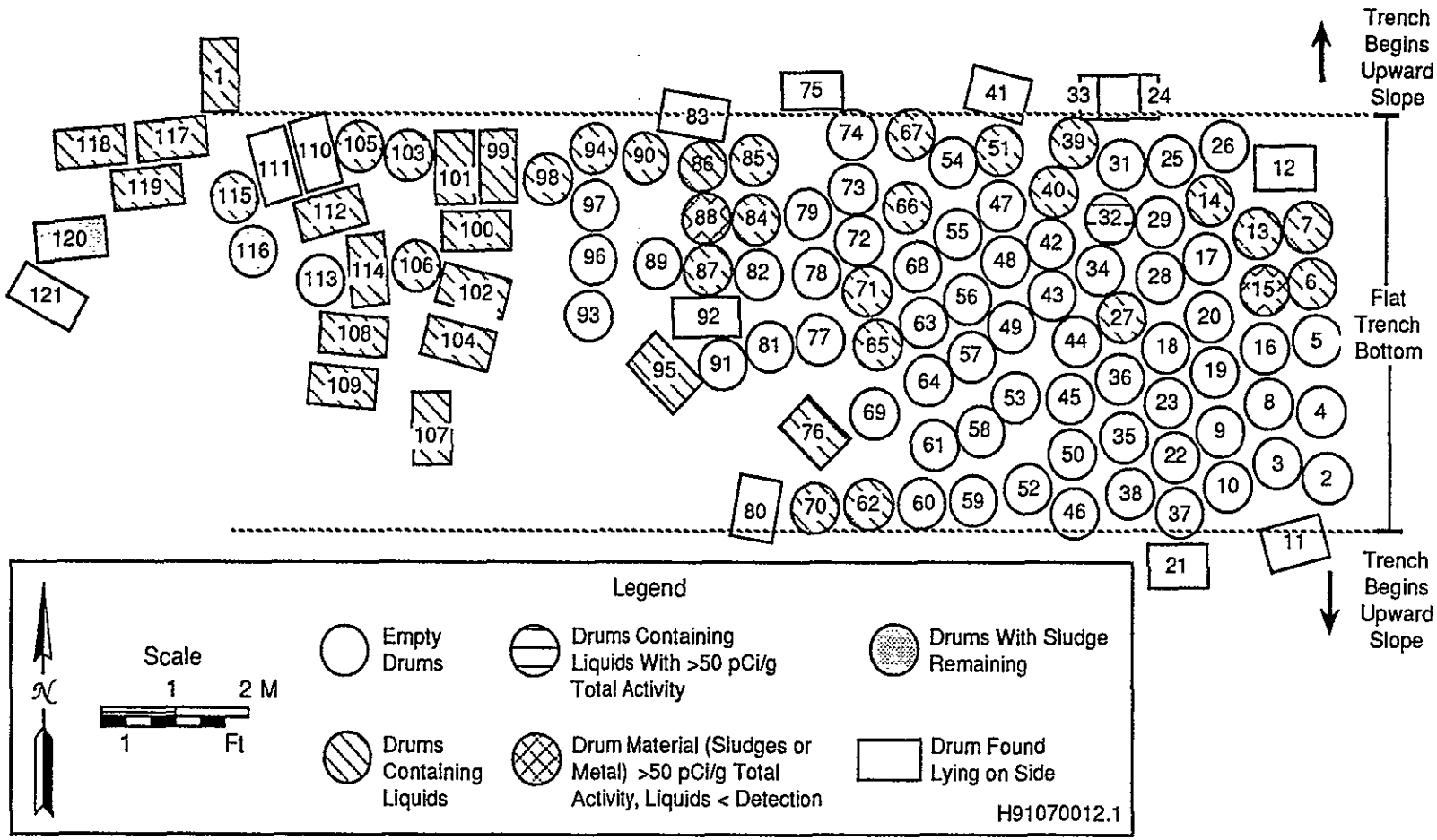

Figure 3-1. Drum Arrangement in Trench Section 1.

To better understand the fate of the MIBK the computer model entitled Seasonal Cycles of Water, Sediment, and Pollutants in Soil Environments (SESOIL; EPA 1986), was used to predict the behavior of MIBK in the unsaturated soil zone. The model was designed to incorporate contaminant inputs, climatic data, chemical properties, and soil parameters to estimate contaminant behavior in soil layers above the groundwater table. The major assumptions used to model the fate and transport of MIBK included:

- Pure MIBK (4,360 gal [16,500 L]) was released 9 to 10 ft (3 m) below the soil surface
- The release was spread evenly over a 5-yr period
- Depth to groundwater is 40 ft (12.2 m) below the soil surface
- Soil from the surface to the water table is primarily sand
- MIBK is not retarded by the soils.

Results of the modeling determined that for the first 1 to 15 yr after the initial leak, predicted concentrations in the soil moisture were expected to be at or near saturation levels (19,000 mg/L) throughout the soil column. In the first 15 yr, concentrations adsorbed to the soil were 5 to 9 mg/kg below the trench, 20 to 40 mg/kg at 10 ft (3 m), and 10 to 20 mg/kg from 1 to 9 ft (.3 to 3 m). Pure product MIBK was also projected to be present for the first 15 yr at 10 ft. Predicted concentrations dropped sharply after 15 yr and were at levels below standard laboratory quantitation limits (0.001 mg/kg for soil, 0.001 mg/L for water) 16 to 18 yr after the leaks began.

Thirty years after the release, dissolved concentrations in the soil column range from 1×10^{9} to 1×10^{8} mg/L and adsorbed concentrations ranged from 2×10^{11} to 2×10^{12} mg/kg, well below detectable levels.

In summary, conservative modeling suggested that MIBK concentrations in the soil would gradually be reduced through dispersion, volatilization, and the natural degradation process. Modeling also suggested that would not be present in the trench 16 to 18 yr after the initial leak.

This modeling does not definitively describe why MIBK has not been detected by sampling activities; however, the following possibilities could be supported by the modeling:

- The MIBK leaked from the drums a long time ago and is no longer present in the environment at detectable levels
- The MIBK is somewhere between the soils at the bottom of the trench and above the aquifer
- Estimates of the source term were too high (modeling suggests that if the drums leaked within the last 20 yr or so, MIBK should have been in the soils.)

3.3 DATA SUMMARY

The chemicals of concern, as evaluated in the preceding text include nitrates, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, chloroform, MIBK, phenanthrene, 1,1,2,2,-tetrachloroethane, trichloroethene, tetrachloroethene, hexachloroethane, and hexachlorobutadiene.

Exposure was not estimated for hexachloroethane since modeling indicated that no leachate is expected to reach the groundwater in the next 100 yr. The biodegradation half-life in soil for hexachloroethane is estimated to be 4 wk to 6 mo (Howard, et al. 1991). Hence, little hexachloroethane is likely to remain 100 yr, which is over 200 half-lives. Exposure was also not estimated for hexachlorobutadiene since fate and transport modeling results indicate that peak concentrations over time in groundwater will only reach less than detectable limits (1×10^{-16} mg/l).

These chemicals of concern will be further evaluated by a risk assessment (Section 4.0) to determine what risks, if any, are posed by the chemical constituents at the site and will be compared with the applicable soil cleanup standards (Section 5.0).

4.0 RISK ASSESSMENT

A risk assessment was conducted to determine whether contaminants in the subsurface soils of the 618-9 Burial Ground pose a potential threat to human health. Because of the desire to address removal actions in a timely manner, the EPA has generally required that the removal action risk assessment support focus on the major concerns at the site and not be as inclusive as a Remedial Investigation (RI) risk assessment. For this reason, rather than conducting a quantitative exposure and risk assessment on all eleven chemicals of concern, a few representative chemicals were chosen for quantitative assessment.

A brief discussion of the relevant components of the risk assessment is provided in the following sections. The complete risk assessment has been provided for future reference in Appendix F.

4.1 IDENTIFY CONSTITUENTS OF CONCERN

A risk assessment initially identifies the constituents of concern. The selection of representative chemicals was based on a toxicity/concentration screening in accordance with EPA guidance (EPA 1989). This process determines which chemicals are likely to cause the highest risk. The representative chemicals were determined to be nitrates, hexachloroethane, hexachlorobutadiene, tetrachloroethene, and 1,1,2,2-tetrachloroethene. Bis(2-ethylhexyl)phthalate was not considered representative since it is a common lab contaminant. Further, it was only detected four times, three of which were at levels below the sample quantification limit. Hence, it was considered unlikely that bis(2-ethylhexyl)phthalate was a site-related contaminant.

4.2 PERFORM EXPOSURE ASSESSMENT

The exposure assessment is a quantitative estimation of daily exposure to chemicals of concern. The chemical-specific exposure estimates for each pathway have been discussed in Appendix E, Chapter 4. No current exposure pathways are assumed to exist, mainly due to the subsurface nature of the soil. It is assumed that future exposure could occur through the groundwater, if someone were to live and drill a well on site.

It was assumed that future exposure will occur through the following pathways; direct ingestion of groundwater, indoor inhalation while showering and from general water use, dermal contact while bathing, ingestion of garden vegetables irrigated with groundwater, and ingestion of beef and milk contaminated by cattle ingesting water.

4.3 FATE AND TRANSPORT MODELING

The model entitled Seasonal Cycles of Water, Sediment, and Pollutants in Soil Environments (SESOIL; EPA 1986) was used to predict the behavior of the chemicals of concern in the unsaturated soil zone. The model was designed to incorporate contaminant inputs, climatic data, chemical properties, and soil parameters to estimate contaminant behavior in soil layers above the groundwater table. The upper 95% confidence interval about the mean soil concentration was used to calculate the

initial input of contaminant to the soil. The contaminant concentration was introduced into the first month of year 1 to the second soil layer in SESOIL at a depth of 9 to 10 ft.

The AT123D model (EPA 1986) was used to estimate groundwater concentrations using output from SESOIL. Output from the AT123D model was used to estimate the groundwater exposure point concentrations.

4.4 RISK ESTIMATES

4.4.1 Carcinogenic Constituents

Table 4-1 summarizes risks associated with each chemical. The excess risk associated with a carcinogen is the product of estimated exposure to a carcinogen and the chemical-specific, route-specific slope factor. Since no current exposure pathways exist, the risks reported in Table 4-1 are for the future exposure scenario (groundwater). These risks are estimates of risk expected if all of the conditions of the exposure scenario are met. Hence, actual risk is likely to be much lower. The total cancer risk for the site is the combined effects of all carcinogens. There are seven carcinogens among the chemicals of concern. Since it is likely that the chemicals evaluated are the chemicals producing the greatest risk, it is also likely that total risk from all seven carcinogens will not exceed 2.5×10^{-7}, or seven times the risk of 1,1,2,2-tetrachloroethane. The risk from each carcinogen evaluated, as well as the total risk expected from all carcinogens, are well under the 1×10^{-6} to 1×10^{-4} risk range that is generally considered acceptable by EPA (1990b).

4.4.2 Hazards from Noncarcinogenic Constituents

Noncarcinogenic effects of chemicals were quantified as hazard indices. A hazard index is the ratio of the estimated daily intake to the reference dose. Hazard Indexes are given in Table 6.1 for the chemicals evaluated. A hazard index less than one is considered to be safe. The hazard quotient for the sum of all toxic effects, was also less than one. Since the chemicals evaluated were selected on the basis of their likelihood of producing higher risk levels, it can be assumed that none of the chemicals of concern appear to represent any future unacceptable noncarcinogenic exposure risk.

Table 4-1. Risk Estimates.

Chemical	Pathway/Route	Hazard Index	Cancer Risk
Nitrates	Drinking Water	0.0015	
	TOTAL	0.0015	
1,1,2,2-Tetrachloroethane			
	Drinking Water		1.83×10^{-8}
	Beef Ingestion		2.12×10^{-13}
	Milk Ingestion		3.22×10^{-13}
	Vegetable Ingestion		1.61×10^{-8}
	Dermal-Bathing		1.25×10^{-11}
	Inhalation-Showering		5.11×10^{-10}
	Inhalation-Other Household Water Use		1.23×10^{-9}
	Total by Route		
	Ingestion		3.44×10^{-8}
	Inhalation		1.74×10^{-9}
	Dermal		1.25×10^{-11}
	TOTAL		3.62×10^{-8}
Tetrachloroethene			
	Drinking Water	0.000019	9.44×10^{-9}
	Beef Ingestion	3.43×10^{-10}	1.75×10^{-13}
	Milk Ingestion	5.27×10^{-10}	2.69×10^{-13}
	Vegetable Ingestion	0.000013	6.62×10^{-9}
	Dermal-Bathing	1.26×10^{-8}	6.43×10^{-12}
	Inhalation-Showering	0.0000017	3.17×10^{-14}
	Inhalation-Other Household Water Use	0.0000046	8.32×10^{-14}
	Total by Route		
	Ingestion	0.000032	1.61×10^{-8}
	Inhalation	0.0000063	1.15×10^{-13}
	Dermal	1.26×10^{-8}	6.43×10^{-12}
	TOTAL	0.000038	1.61×10^{-8}

[a] The Hazard Index is the ratio of the estimated intake of a noncarcinogen over the reference dose.
[b] The cancer risk is the probability of contracting cancer over a lifetime from exposure to the hazardous agent.

5.0 APPLICABLE, RELEVANT, AND APPROPRIATE REQUIREMENTS

The basic description of ARAR is provided in Section 7.5 of the Action Plan in the Tri-Party Agreement (Ecology et al. 1989, Attachment 2.0). The RI/FS process will identify final cleanup standards and ARARs that will be applied during the final remediation of the 300-FF-2 operable unit. The following sections provide a brief discussion of pertinent ARARs to the 618-9 Burial Ground ERA. The ARARs were based upon the Model Toxics Control Act.

Since the focus of the removal action pertains to contaminated soil, ARARs for air and water were not identified and were not considered applicable; however, any secondary effluent streams that could be generated through further remediation actions would be subject to federal and state regulations.

5.1 FEDERAL AND STATE

There are no specific federal cleanup standards or chemical-specific ARARs for compounds in soil (hazardous) except for the EPA standards for lead and radium; however, soil standards were recently promulgated by the State of Washington (WAC 173-340). The state regulations require attainment of cleanup standards for final remediation activities and specify that interim actions (ERA) may: (1) achieve cleanup standards for a portion of the site, (2) cleanup hazardous substances from all or part of the site, but not achieve cleanup standards, or (3) provide a partial cleanup of hazardous substances and not achieve cleanup standards, but provide information on how to achieve cleanup standards. Specific cleanup standards for contaminants identified through site characterization activities are listed in Table 5-1. These standards were derived from Methods A and B of the Model Toxics Control Act (Ecology 1990).

5.2 COMPARISON OF SOIL STANDARDS AND SOIL DATA

As identified in Table 5-1, the chemicals of concern identified in Section 3.0 do not exist in the trench at levels greater than the applicable soil standards, and do not indicate the need for further cleanup actions at the 618-9 Burial Ground.

Table 5-1. Comparison of Detected Soil Concentrations and Soil Cleanup Levels.

Chemical	Upper 95% concentration in soil (mg/kg)	Model Toxic Control Act levels (mg/kg)[a]
Nitrates	265.71	128,000
Bis(2-ethylhexyl)phthalate	2.16	71.4
Butylbenzylphthalate	1.26	16,000
Chloroform	0.00388	164
MIBK	1.3[b]	4,000
Phenanthrene	0.217	[c]
1,1,2,2-Tetrachloroethane	0.0294	5.0
Trichloroethene	0.00253	0.5[d]
Tetrachloroethene	0.156	0.5[d]
Hexachloroethane	5.81	71.4
Hexachlorobutadiene	0.295	12.8

[a] WAC 173-340-740 Soil Cleanup Standards, Method B, except where noted.
[b] Highest sample quantification used since MIBK was not detected.
[c] No data in the Integrated Risk Information System Database (IRIS) and Health Effects Assessment Summary Tables: Annual FY 1991 (EPA 1991), OERR 9200.6-303(9101).
[d] WAC 173-340-740 Soil Cleanup Standards, Method A.

6.0 CONCLUSIONS AND RECOMMENDATIONS

As specified in 40 CFR 300, ERAs are to be implemented at CERCLA sites where early remediation activities will abate potential threats or prevent significant or increased degradation that might occur if action were delayed until completion of remediation activities at the operable unit.

The purpose of the ERA for the 618-9 Burial Ground was to remove the potential human health and environmental hazards associated with continued leakage of the buried MIBK contaminated drums. The original strategy for implementation of the 618-9 Burial Ground ERA was two-fold: (1) remove the contaminated leaking drums, and (2) treat contaminated soil as necessary.

Since development of the original ERA strategy, Phase I of the ERA has been completed. Approximately 1,600 gal (6,000 L) of solvent were removed from the environment, in addition to building and processing equipment debris. Sample data collected from the recovered solvents and surrounding soil have indicated minimal concentrations, if any, are remaining at the 618-9 Burial Ground (Table 5-1).No chemicals in the trench exceed ARARs. Additionally, results of the risk assessment have indicated that there is negligible risk to human health and the environment from the chemical constituents remaining in the soils. Further remediation in Phase II activities is not warranted by existing levels of contamination.

As a result, it is recommended that the ERA for the 618-9 Burial Ground be considered complete and the following actions implemented:

- Final disposal of the recovered solvent and other waste generated during excavation of the 618-9 Burial Ground in accordance with applicable federal and state regulations
- Backfill the 618-9 Burial Ground and revegetate the site
- Survey actual trench boundaries and mark for future reference.

Should the DOE, EPA, and Ecology deem it advantageous to remove the 618-9 Burial Ground from further consideration as a past-practice site, it is recommended that a Record of Decision on the 618-9 Burial Ground ERA be issued.

The groundwater beneath and surrounding the 618-9 Burial Ground will continue to be monitored and if necessary remediated as part of the 300-FF-5 operable unit, as discussed in the 300-FF-5 Operable Unit Work Plan. As the 618-9 Burial Ground is included within the 300-FF-5 operable unit, regional groundwater contamination is not considered a controlling factor in finalizing actions for remediation of the 618-9 Burial Ground.

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APPENDIXES

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APPENDIX A

WASTE INFORMATION DATA SYSTEM

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Waste Information Data System
General Summary Report
June 11, 1991

SITE NAME: 618-9 [309]
ALIASES:
300 West Burial Ground [309]; 318-9 [17]

SITE TYPE: Burial Ground [309]
WASTE CATEGORY: Mixed Waste [309]
WASTE TYPE: Solid [309]

STATUS: Inactive [309] Pre-1980 [309]
START DATE: 1950 [309]
END DATE: 1954 ?1956 [309]? [NR]

OPERABLE UNIT: 300-FF-2 [329]
REG. AUTHORITY: CERCLA Past Practice [323]
DOE/RL PROGRAM: Radiation Areas Reduction [358]

This site is included in the Tri-Party Agreement Action Plan [329]

Hazardous Ranking System Migration Score: 0.00 [309]

DESIGNATED AREA: 600 Area [309]
COORDINATES:
N55738 E11016, N55738 E10998, N55938 E11016, N55938 E10998 [309]
LOCATION:
~3/4 mi northwest of the 300 Area [17] and 1,500 ft southwest of the 618-7 site [NR]

GROUND ELEVATION: 400.00 feet above MSL [309]
WATER TABLE DEPTH: 58.00 feet below grade [309]

SITE DIMENSIONS:

Length:	200.00	feet [309]
Width:	18.00	feet [309]
Depth:	8.00	feet [309]

SITE DESCRIPTION:
The unit consists of a trench 18 to 20 ft wide by 140 ft long (surface dimensions). Adjacent to the trench is a mound of contaminated soil from the 303 Area that was covered over with 4 ft of clean soil [309].

WASTE TYPES AND AMOUNTS:
The site contains 55-gal drums of uranium-contaminated organic solvent (5,000 gal) from the 321 Building [309].

CLEANUP ACTIONS:
The unit was removed from service, backfilled, identified with markers, and stabilized [309].

SITE NAME: 618-9

SURVEILLANCE INFORMATION [473]

SURVEILLANCE DATE: 11/89
SURVEY SCHEDULE: Annual
SITE POSTING: Surface Contamination

RESULTS/STATUS: No contamination reported. No change since survey of 12/88.

ACTION REQUIRED: Posting change option delayed due to suspicion of misidentification of actual trench location.

These results show the unit to be in compliance with the Environmental Compliance Manual.

APPENDIX B

SOIL GAS SURVEY RESULTS

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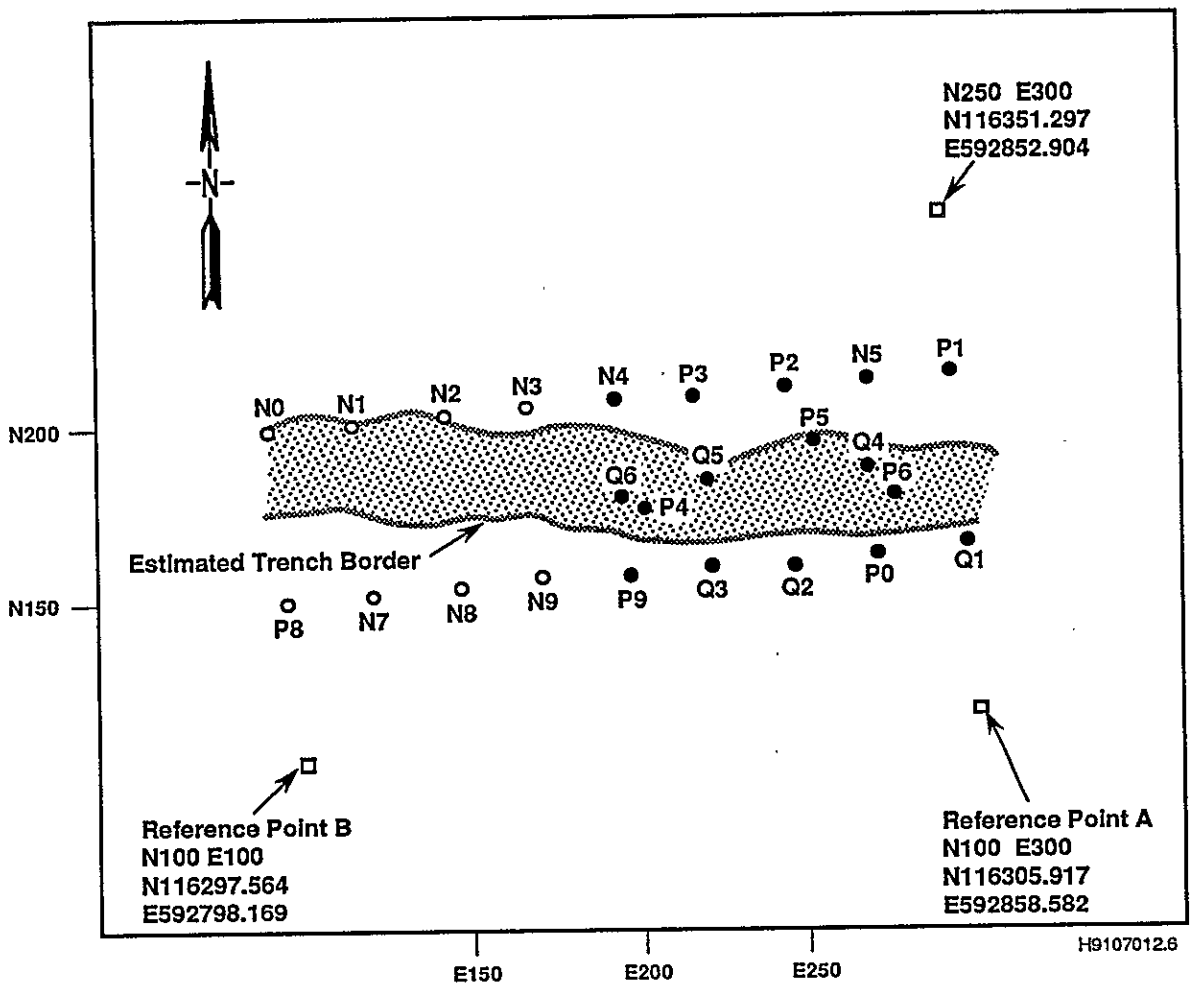
As depicted in Figure B-1, a soil gas survey was conducted to verify the presence of hexone and other volatile organic carbons (VOCs) at the burial ground. A total of 24 soil gas samples were collected and qualitatively analyzed via a gas chromatograph. Five common organic compounds were used as standards in the gas chromatograph: benzene, toluene, ethylbenzene, M-xylene, and O-xylene. Of the 24 samples collected, 16 identified the presence of unknown VOCs. The unknown VOCs were observed in the eastern half of the burial ground. Table B-1 contains a summary of the samples collected and associated data.

Figure B-1. Location of Soil Gas Sampling



N200 Surveyed Grid Lines
o Sample Location
● Sample Showing Unknowns VOC's
N2 Sample Identification Number
last two digits
example: BOODN2

Table B-1. Summary of Soil Gas Sampling Data

Sample No.	Compound Detected	Toluene Equivalence (ppm)
BOODN0	ND	NA
BOODN1	ND	NA
BOODN2	ND	NA
BOODN3	ND	NA
BOODN4	unk	0.11
BOODN5	unk	0.98
BOODN5(dup)	unk	0.98
BOODN7	ND	NA
BOODN8	ND	NA
BOODN9	ND	NA
BOODP0	unk	0.62
BOODP1	unk	0.47
BOODP2	unk	0.26
BOODP3	unk	0.12
BOODP4	unk	1.40
BOODP5	unk	1.95
BOODP6	unk	0.47
BOODP8	ND	NA
BOODP9	unk	0.11
BOODP9(dup)	unk	0.11
BOODQ1	unk	0.23
BOODQ2	unk	0.67
BOODQ3	unk	0.40
BOODQ4	unk	1.33
BOODQ5	unk	1.56
BOODQ6	unk	0.51

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APPENDIX C

HISTORICAL GROUNDWATER DATA

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GROUNDWATER NEAR THE 618-9 BURIAL GROUND

Jane V. Borghese

Groundwater near the 618-9 Burial Ground, located west of the 300 Area, is discussed in the following sections. Detailed discussions of groundwater flow, direction, and chemistry for the 300 Area can be found in DOE (1990) and Schalla et al. (1988).

Wells Open to the Unconfined Aquifer

Wells open to the unconfined aquifer near the 618-9 Burial Ground are 399-8-4 and 399-8-2. Well 399-8-4 is located approximately 100 ft southeast of the southeast corner of the burial ground. Well 399-8-2 is located approximately 1,100 ft east of 399-8-4. Other wells of interest are 399-8-1 and 399-6-1, located 2,500 ft east and 6,800 ft southeast, respectively, from well 399-8-4. Locations of these wells are shown in Figure C-1. These wells are cased with carbon-steel casing having perforated intervals with depths ranging from about 20 to 100 ft below the water table (Schalla et al., 1988).

Groundwater Flow Direction

The groundwater flow direction is predominantly to the east (Figures C-1 and C-2). Seasonal changes may occur in the water level of the unconfined aquifer near the burial ground, but the flow direction remains generally to the east in the immediate area of the burial ground. East of well 399-8-2, the direction of flow may be to the southeast or east depending on natural and anthropogenic factors (DOE 1990). Wells downgradient from the burial ground are 399-8-4, 399-8-2, 399-8-1 and 399-6-1. Because of the potential changes in groundwater flow direction well 399-6-1 is included as a downgradient well. However, wells 399-8-1 and 399-6-1 may be downgradient from other facilities besides 618-9 Burial Ground.

Groundwater Chemistry

The analytical results and a constituent summary for water samples collected from wells 399-8-4 and 399-8-2 located immediately downgradient from the burial ground, and wells 399-8-1 and 399-6-1, are listed in Table 1. Constituents that are of interest based on what was disposed of in the Burial Ground or detected in the soil are uranium, volatile organic compounds, and nitrates.

The results of uranium analysis for recent data from the aforementioned four wells and results of uranium analysis of other 300 Area wells (Evans et al., 1990) indicate that the concentration of uranium increases to the east of the burial ground. The increase of uranium to the east of 618-9 burial ground is associated with the uranium plumes of the 300 Area (Evans et al., 1990). The uranium plumes are centered around the 300 Area Process Trenches (316-5) and south of the South Process Ponds (316-1).

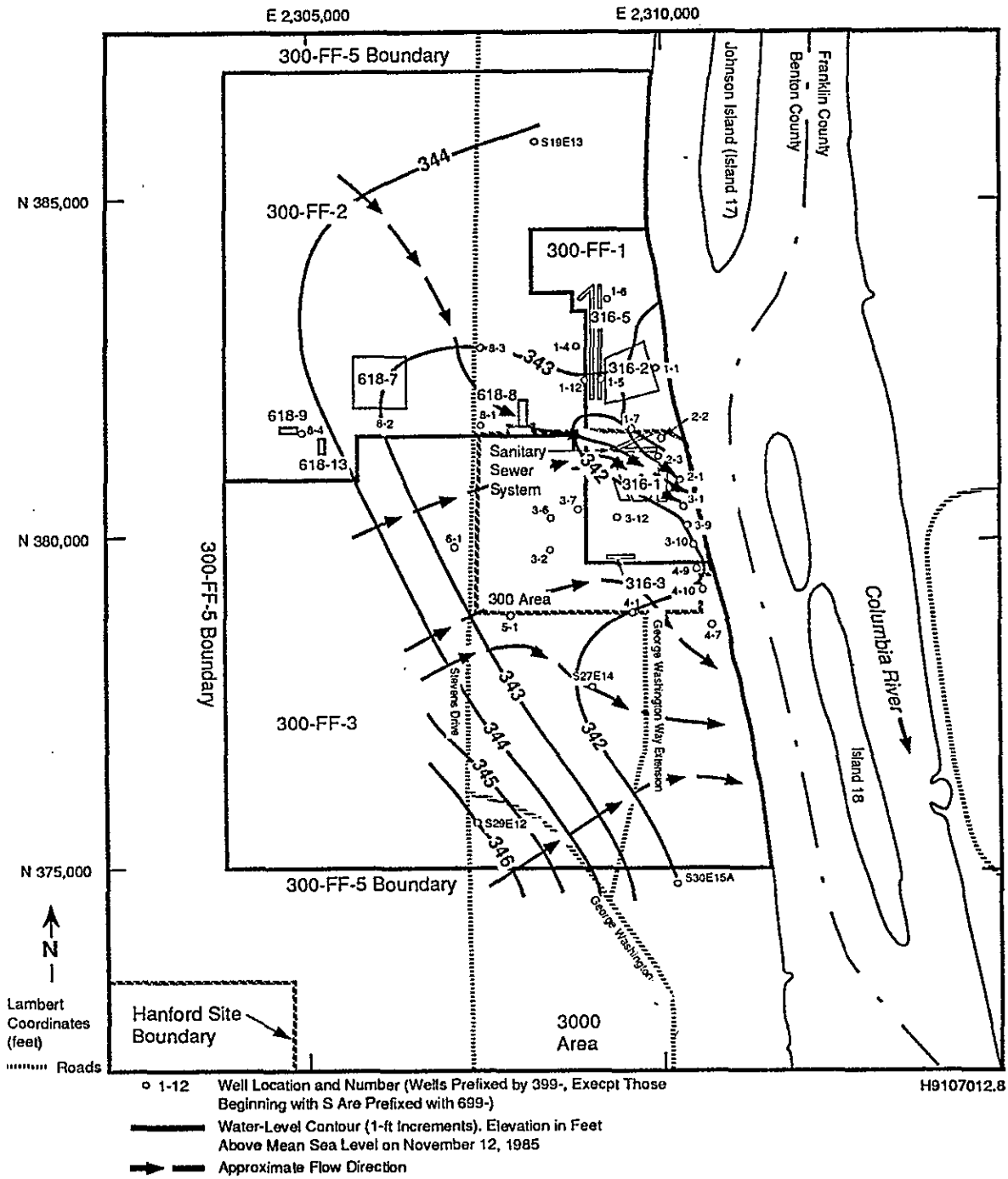

Figure C-1. Water-Level Contour Map of the Unconfined Aquifer, Measured on November 12, 1985 (after Schalla et al. 1988)

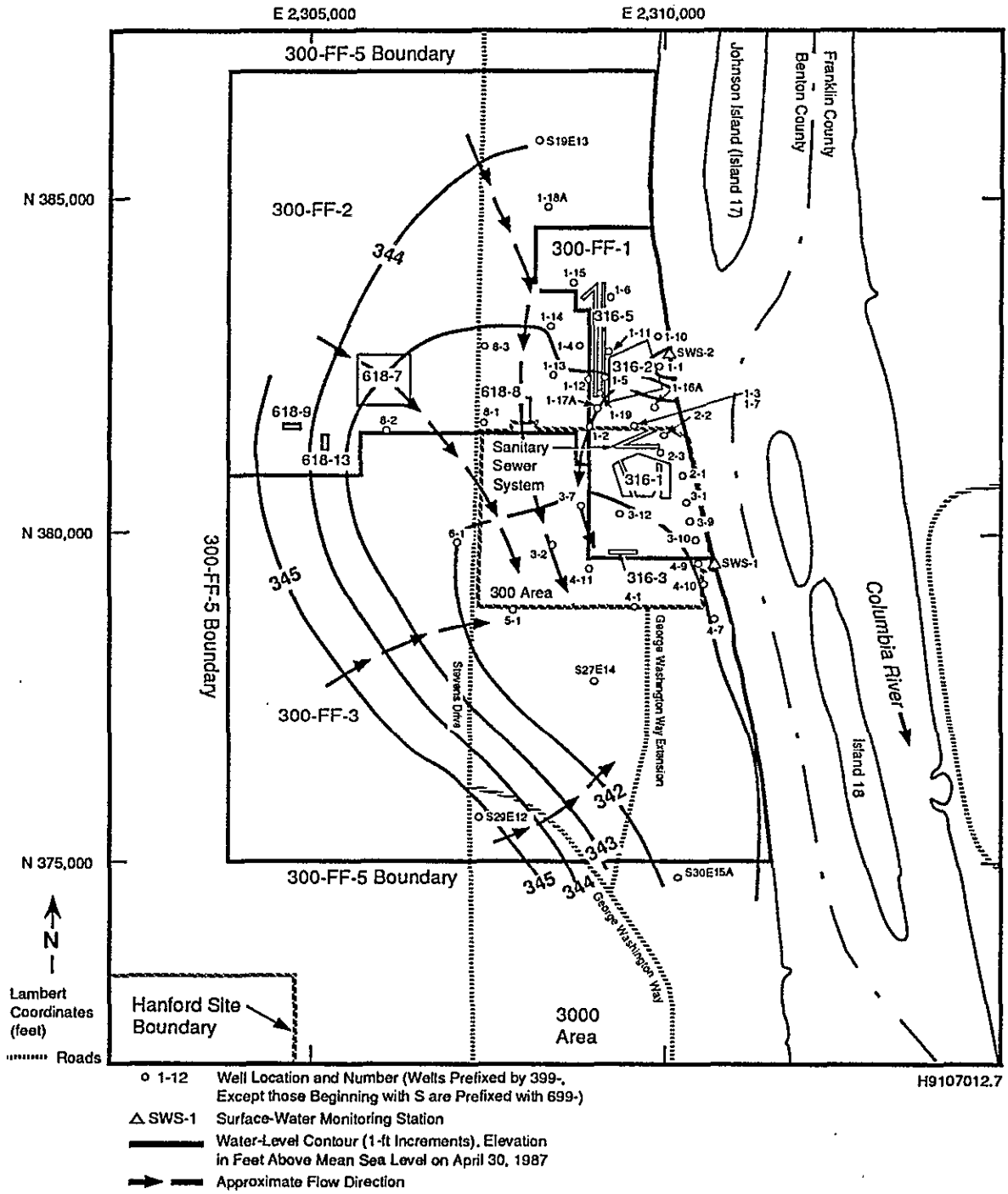

Figure C-2. Water-Level Contour Map of the Unconfined Aquifer, Measured on April 30, 1987 (after Schalla et al. 1988).

Water samples collected from wells 399-8-1 and 399-8-2 collected in 1985 through 1988 detected volatile organic constituents of: total organic halogen, 1,1,1-trichloroethane, methylene chloride, and tetrachloroethylene from well 399-8-2 and total organic halogen from well 399-8-1. Volatile organic compound analysis on a recent water sample (June 1989) from well 399-8-2 did not detect any volatile organic compounds above the contractual detection limit except for total organic halogen at 11 ppb. Samples for volatile compounds analysis were collected using a submersible pump for well 399-8-1, and a bladder pump for well 399-8-2. Concern has been expressed on the use of submersible pumps for collection of water samples for analyses of volatile organic compounds, because of air entrained in the water during pumping. Samples from wells 399-8-4 and 399-8-3 were not analyzed for volatile organic compounds.

Nitrates have been detected in wells 399-8-4, 399-8-2, 399-8-1, and 399-6-1 from the start of sample collection in the early 1960's through the most recent sampling event. All of the results are below nitrate's maximum contaminant limit of 45 mg/L, with the exception of a sample collected from well 399-8-1. A nitrate concentration (phenodisulfonic acid method) was measured at 71 mg/L from a sample collected on 6/25/69. The following sampling event for this well on 7/28/69 had a nitrate concentration of 13 mg/L.

Summary

The groundwater near the 618-9 Burial Ground is monitored by an adjacent well 399-8-4. Other downgradient wells are 399-8-2, 399-8-1 and potentially 399-6-1. These carbon steel wells are open to different depths of the unconfined aquifer. The groundwater flow direction near the burial ground is to the east. Samples for chemical analyses have been collected from wells near the burial ground since the early 1950's. Recent uranium concentrations of samples collected from these wells show an increase to the east of the burial ground. Volatile organic compounds have been detected in groundwater collected from wells 399-8-2 and 399-8-1. Recent analyses for volatile organic compounds of samples from wells 399-8-2 and 399-8-1 have detected only total organic halogen in the sample from 399-8-2. Nitrates have been detected in wells near the burial ground. All but one value has been below the maximum contaminant limit of 45 mg/L.

References

DOE, 1990, Remedial Investigation/Feasibility Study Work Plan for the 300-FF-5 Operable Unit, Hanford Site, Richland, Washington, DOE/RL-89-14, U.S. Department of Energy-Richland Operations Office, Richland, Washington.

Evans, J. C., D. J. Bates, R. W. Bryce, and M. L. Kemner, 1990, Hanford Site Ground-Water Surveillance for 1989, PNL-7396, Pacific Northwest Laboratory, Richland, Washington.

Schalla, R., R. L. Aaberg, S. P. Airhart, D. J. Bates, J. V. M. Carlile, C. S. Cline, D. I. Dennison, M. D. Freshley, P. R. Heller, E. J. Jensen, K. B. Olsen, R. G. Parkhurst, J. T. Rieger, R. W. Wallace, and E. J. Westergard, 1988, Interim Characterization Report for the 300 Area Process Trenches, PNL-6716, Pacific Northwest Laboratory, Richland, Washington.

8/26/91

Geosciences Group PARADOX Database

Quantitative Summary Report

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
0,0-Diethyl-0,2-pyrazinyl phospho	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
0,0-Diethyl-0,2-pyrazinyl phospho	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
1,1,1,2-tetrachlorethane	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
1,1,1,2-tetrachlorethane	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
1,1,1-trichloroethane	PPB	3-8-1	5/23/90	< 5.00	5.00	5.00	5.00	8	0
1,1,1-trichloroethane	PPB	3-8-2	6/13/89	< 5.00	12.31	83.00	4.00	29	4
1,1,2,2-tetrachlorethane	PPB	3-8-1	4/12/90	< 5.00	6.67	10.00	5.00	3	0
1,1,2,2-tetrachlorethane	PPB	3-8-2	6/13/89	< 5.00	7.50	10.00	5.00	2	0
1,1,2-trichloroethane	PPB	3-8-1	5/23/90	< 5.00	5.00	5.00	5.00	8	0
1,1,2-trichloroethane	PPB	3-8-2	6/13/89	< 5.00	8.86	10.00	2.00	29	0
1,1-dichloroethane	PPB	3-8-1	5/23/90	< 5.00	6.00	10.00	5.00	5	0
1,1-dichloroethane	PPB	3-8-2	6/13/89	< 5.00	7.50	10.00	5.00	2	0
1,1-dichloroethylene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
1,1-dichloroethylene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
1,1-dimethylhydrazine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
1,1-dimethylhydrazine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
1,2,3,4-tetrachlorobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
1,2,3,4-tetrachlorobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	14	0
1,2,3,5-tetrachlorobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
1,2,3,5-tetrachlorobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	14	0
1,2,3-trichlorobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
1,2,3-trichlorobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	14	0
1,2,3-trichloropropane	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
1,2,3-trichloropropane	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
1,2,4,5-tetrachlorobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
1,2,4,5-tetrachlorobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	14	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS			CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling		Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
1,2,4-trichlorobenzene	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
1,2,4-trichlorobenzene	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	14	0
1,2-dibromo-3-chloropropane	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
1,2-dibromo-3-chloropropane	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
1,2-dibromoethane	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
1,2-dibromoethane	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
1,2-dichlorobenzene	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
1,2-dichlorobenzene	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	14	0
1,2-dichloroethane	PPB	3-8-1	5/23/90	<	5.00	6.00	10.00	5.00	5	0
1,2-dichloroethane	PPB	3-8-2	6/13/89	<	5.00	7.50	10.00	5.00	2	0
1,2-dichloropropane	PPB	3-8-1	4/12/90	<	5.00	6.67	10.00	5.00	3	0
1,2-dichloropropane	PPB	3-8-2	6/13/89	<	5.00	7.50	10.00	5.00	2	0
1,2-dimethylhydrazine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	2	0
1,2-dimethylhydrazine	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	1	0
1,2-diphenylhydrazine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
1,2-diphenylhydrazine	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
1,3,5-trichlorobenzene	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
1,3,5-trichlorobenzene	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	14	0
1,3-dichlorobenzene	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
1,3-dichlorobenzene	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	14	0
1,3-dichloropropene	PPB	3-8-1	4/12/90	<	5.00	6.67	10.00	5.00	3	0
1,3-dichloropropene	PPB	3-8-2	6/13/89	<	5.00	7.50	10.00	5.00	2	0
1,4-dichloro-2-butene	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
1,4-dichloro-2-butene	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
1,4-naphthoquinone	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
1,4-naphthoquinone	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
1-(o-chlorophenyl) thiourea	PPB	3-8-1	4/12/90	< 200.00	200.00	200.00	200.00	3	0
1-(o-chlorophenyl) thiourea	PPB	3-8-2	6/13/89	< 200.00	200.00	200.00	200.00	2	0
1-Butanol	PPB	3-8-1	4/12/90	< 10000.00	10000.00	10000.00	10000.00	2	0
1-Butanol	PPB	3-8-2	6/13/89	< 10000.00	10000.00	10000.00	10000.00	1	0
1-Butynol	PPB	3-8-1	4/12/90	< 10000.00	10000.00	10000.00	10000.00	2	0
1-Butynol	PPB	3-8-2	6/13/89	< 10000.00	10000.00	10000.00	10000.00	1	0
1-Propanol	PPB	3-8-1	4/12/90	< 10000.00	10000.00	10000.00	10000.00	2	0
1-Propanol	PPB	3-8-2	6/13/89	< 10000.00	10000.00	10000.00	10000.00	1	0
1-acetyl-2-thiourea	PPB	3-8-1	4/12/90	< 200.00	200.00	200.00	200.00	3	0
1-acetyl-2-thiourea	PPB	3-8-2	6/13/89	< 200.00	200.00	200.00	200.00	2	0
1-chloro-2,3-epoxypropane	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
1-chloro-2,3-epoxypropane	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
1-naphthyl-2-thiourea	PPB	3-8-1	4/12/90	< 200.00	200.00	200.00	200.00	3	0
1-naphthyl-2-thiourea	PPB	3-8-2	6/13/89	< 200.00	200.00	200.00	200.00	2	0
1-naphthylamine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
1-naphthylamine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2,3,4,6-tetrachlorophenol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2,3,4,6-tetrachlorophenol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2,3,7,8 TCDD	PPB	3-8-1	4/12/90	< .01	.01	.01	.01	2	0
2,3,7,8 TCDD	PPB	3-8-2	6/13/89	< .01	.01	.01	.01	1	0
2,4,5-T	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	5	0
2,4,5-T	PPB	3-8-2	6/13/89	< 2.00	2.00	2.00	2.00	3	0
2,4,5-TP silvex	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	7	0
2,4,5-TP silvex	PPB	3-8-2	6/13/89	< 2.00	1.24	2.00	1.00	21	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
2,4,5-Trichlorophenol	PPB	3-8-1	4/12/90	< 10.00	23.33	50.00	10.00	3	0
2,4,5-Trichlorophenol	PPB	3-8-2	6/13/89	< 10.00	30.00	50.00	10.00	2	0
2,4,6-trichlorophenol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2,4,6-trichlorophenol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2,4-D	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	7	0
2,4-D	PPB	3-8-2	6/13/89	< 2.00	1.24	2.00	1.00	21	0
2,4-dichlorophenol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2,4-dichlorophenol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2,4-dimethylphenol	PPB	3-8-1	5/10/88	< 10.00	10.00	10.00	10.00	1	0
2,4-dimethylphenol	PPB	3-8-2	5/10/88	< 10.00	10.00	10.00	10.00	1	0
2,4-dinitrophenol	PPB	3-8-1	4/12/90	< 10.00	23.33	50.00	10.00	3	0
2,4-dinitrophenol	PPB	3-8-2	6/13/89	< 10.00	30.00	50.00	10.00	2	0
2,4-dinitrotoluene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2,4-dinitrotoluene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2,6-dichlorophenol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2,6-dichlorophenol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2,6-dinitrotoluene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2,6-dinitrotoluene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-Hexanone	PPB	3-8-1	4/12/90	< 50.00	50.00	50.00	50.00	2	0
2-Hexanone	PPB	3-8-2	6/13/89	< 50.00	50.00	50.00	50.00	1	0
2-Methylnaphthalene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
2-Methylnaphthalene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
2-acetylaminofluorene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-acetylaminofluorene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-chloroethyl vinyl ether	PPB	3-8-1	4/12/90	< 5.00	6.67	10.00	5.00	3	0
2-chloroethyl vinyl ether	PPB	3-8-2	6/13/89	< 5.00	7.50	10.00	5.00	2	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
2-chloronaphthalene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-chloronaphthalene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-chlorophenol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-chlorophenol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-cyclohexyl-4,6-dinitrophenol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-cyclohexyl-4,6-dinitrophenol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-methyl-2-(methylthio) propional	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-methyl-2-(methylthio) propional	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-methylaziridine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-methylaziridine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-methyllactonitrile	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-methyllactonitrile	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-naphthylamine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-naphthylamine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-picoline	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-picoline	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
2-propyn-1-ol	PPB	3-8-1	4/12/90	< 10000.00	9333.33	10000.00	8000.00	3	0
2-propyn-1-ol	PPB	3-8-2	6/13/89	< 10000.00	9000.00	10000.00	8000.00	2	0
2-sec-butyl-4,6-dinitrophenol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
2-sec-butyl-4,6-dinitrophenol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
3,3'-Dichlorobenzidine	PPB	3-8-1	4/12/90	< 10.00	13.33	20.00	10.00	3	0
3,3'-Dichlorobenzidine	PPB	3-8-2	6/13/89	< 10.00	15.00	20.00	10.00	2	0
3,3'-dimethoxybenzidine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
3,3'-dimethoxybenzidine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
3,3'-dimethylbenzidine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
3,3'-dimethylbenzidine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
3-chloropropionitrile	PPB	3-8-1	4/12/90	< 10000.00	8000.00	10000.00	4000.00	3	0
3-chloropropionitrile	PPB	3-8-2	6/13/89	< 10000.00	7000.00	10000.00	4000.00	2	0
3-methylcholanthrene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
3-methylcholanthrene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
4,4'-methylenebis(2-chloroaniline	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
4,4'-methylenebis(2-chloroaniline	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
4,6-dinitro-o-cresol and salts	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
4,6-dinitro-o-cresol and salts	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
4-Nitroquinoline 1-oxide	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
4-Nitroquinoline 1-oxide	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
4-aminobyphenyl	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
4-aminobyphenyl	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
4-bromophenyl phenyl ether	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
4-bromophenyl phenyl ether	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
5-(aminomethyl)-3-isoxazolol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
5-(aminomethyl)-3-isoxazolol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
5-nitro-o-toluidine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
5-nitro-o-toluidine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
7,12-dimethylbenz[a]anthracene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
7,12-dimethylbenz[a]anthracene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
7H-dibenzo[c,g]carbazole	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
7H-dibenzo[c,g]carbazole	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Acenaphthalene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Acenaphthalene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Acenaphthene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Acenaphthene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Acetone - by ABN	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Acetone - by ABN	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Acetone by VOA	PPB	3-8-1	5/23/90	< 10.00	10.00	10.00	10.00	4	0
Acetone by VOA	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Acetonitrile	PPB	3-8-1	4/12/90	< 10.00	1006.67	3000.00	10.00	3	0
Acetonitrile	PPB	3-8-2	6/13/89	< 10.00	1505.00	3000.00	10.00	2	0
Acetophenone	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Acetophenone	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Acrolein	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Acrolein	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Acrylamide	PPB	3-8-1	4/12/90	< 10000.00	10000.00	10000.00	10000.00	3	0
Acrylamide	PPB	3-8-2	6/13/89	< 10000.00	10000.00	10000.00	10000.00	2	0
Acrylonitrile	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Acrylonitrile	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Aldrin	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	3	0
Aldrin	PPB	3-8-2	6/13/89	< .10	.10	.10	.10	2	0
Alkalinity		3-8-1	5/23/90	115000.00	114800.00	120000.00	112000.00	5	5
Alkalinity		3-8-2	6/13/89	129000.00	128500.00	129000.00	128000.00	2	2
Allyl Chloride	PPB	3-8-1	4/12/90	< 100.00	100.00	100.00	100.00	2	0
Allyl Chloride	PPB	3-8-2	6/13/89	< 100.00	100.00	100.00	100.00	1	0
Allyl alcohol	PPB	3-8-1	4/12/90	< 10000.00	7500.00	10000.00	2500.00	3	0
Allyl alcohol	PPB	3-8-2	6/13/89	< 10000.00	6250.00	10000.00	2500.00	2	0
Alpha, High Detection Level	PCI/L	3-6-1	6/25/81	17.00	17.00	17.00	17.00	1	1
Alpha, High Detection Level	PCI/L	3-8-1	4/12/90	3.94	7.13	17.00	2.69	4	2

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Alpha, High Detection Level	PCI/L	3-8-2	6/13/89	1.87	9.44	17.00	1.87	2	1
Alpha, High Detection Level	PCI/L	3-8-4	6/25/81	17.00	17.00	17.00	17.00	2	2
Alpha,alpha-dimethylphenethylamin	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Alpha,alpha-dimethylphenethylamin	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Alpha-BHC	PPB	3-8-1	4/12/90 <	.10	.10	.10	.10	7	0
Alpha-BHC	PPB	3-8-2	6/13/89 <	.10	.79	1.00	.10	21	0
Aluminum	PPB	3-8-1	4/12/90 <	150.00	150.00	150.00	150.00	7	0
Aluminum	PPB	3-8-2	6/13/89 <	150.00	154.90	288.00	150.00	29	2
Aluminum, filtered	PPB	3-8-1	4/12/90 <	150.00	150.00	150.00	150.00	7	0
Aluminum, filtered	PPB	3-8-2	6/13/89 <	150.00	150.00	150.00	150.00	15	0
Amitrole	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Amitrole	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Ammonium ion.	PPB	3-8-1	4/12/90 <	50.00	50.00	50.00	50.00	4	0
Ammonium ion	PPB	3-8-2	6/13/89 <	50.00	74.88	190.00	50.00	27	10
Aniline	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Aniline	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Anthracene	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	2	0
Anthracene	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	1	0
Antimony	PPB	3-8-1	4/12/90 <	100.00	100.00	100.00	100.00	5	0
Antimony	PPB	3-8-2	6/13/89 <	100.00	100.00	100.00	100.00	16	0
Antimony, filtered	PPB	3-8-1	4/12/90 <	100.00	100.00	100.00	100.00	5	0
Antimony, filtered	PPB	3-8-2	6/13/89 <	100.00	100.00	100.00	100.00	3	0
Aramite	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Aramite	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Arochlor 1016	PPB	3-8-1	4/12/90 <	1.00	1.00	1.00	1.00	3	0
Arochlor 1016	PPB	3-8-2	6/13/89 <	1.00	1.00	1.00	1.00	2	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Arochlor 1221	PPB	3-8-1	4/12/90	< 1.00	1.00	1.00	1.00	3	0
Arochlor 1221	PPB	3-8-2	6/13/89	< 1.00	1.00	1.00	1.00	2	0
Arochlor 1232	PPB	3-8-1	4/12/90	< 1.00	1.00	1.00	1.00	3	0
Arochlor 1232	PPB	3-8-2	6/13/89	< 1.00	1.00	1.00	1.00	2	0
Arochlor 1242	PPB	3-8-1	4/12/90	< 1.00	1.00	1.00	1.00	3	0
Arochlor 1242	PPB	3-8-2	6/13/89	< 1.00	1.00	1.00	1.00	2	0
Arochlor 1248	PPB	3-8-1	4/12/90	< 1.00	1.00	1.00	1.00	3	0
Arochlor 1248	PPB	3-8-2	6/13/89	< 1.00	1.00	1.00	1.00	2	0
Arochlor 1254	PPB	3-8-1	4/12/90	< 1.00	1.00	1.00	1.00	3	0
Arochlor 1254	PPB	3-8-2	6/13/89	< 1.00	1.00	1.00	1.00	2	0
Arochlor 1260	PPB	3-8-1	4/12/90	< 1.00	1.00	1.00	1.00	3	0
Arochlor 1260	PPB	3-8-2	6/13/89	< 1.00	1.00	1.00	1.00	2	0
Arsenic	PPB	3-8-1	4/12/90	5.00	5.43	7.00	5.00	7	5
Arsenic	PPB	3-8-2	6/13/89	6.00	5.40	9.00	5.00	29	11
Arsenic, filtered	PPB	3-8-1	4/12/90	< 5.00	5.43	7.00	5.00	7	5
Arsenic, filtered	PPB	3-8-2	6/13/89	5.00	5.49	10.00	5.00	15	8
Auramine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Auramine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Barium	PPB	3-8-1	4/12/90	36.00	35.14	39.00	30.00	7	7
Barium	PPB	3-8-2	6/13/89	38.00	39.76	46.00	35.00	29	29
Barium, filtered	PPB	3-8-1	4/12/90	35.00	37.14	42.00	32.00	7	7
Barium, filtered	PPB	3-8-2	6/13/89	37.00	39.80	46.00	36.00	15	15
Benz[a]anthracene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Benz[a]anthracene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Benz[c]acridine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Benz[c]acridine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Benzene	PPB	3-8-1	5/23/90	< 5.00	5.00	5.00	5.00	5	0
Benzene	PPB	3-8-2	6/13/89	< 5.00	9.33	10.00	5.00	15	0
Benzene, dichloromethyl	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Benzene, dichloromethyl	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Benzenethoil	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Benzenethoil	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Benzidine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Benzidine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Benzo(ghi)perylene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Benzo(ghi)perylene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Benzo(k)Fluoranthene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Benzo(k)Fluoranthene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Benzo[a]pyrene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Benzo[a]pyrene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Benzo[b]fluoranthene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Benzo[b]fluoranthene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Benzo[j]fluoranthene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Benzo[j]fluoranthene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Benzyl Alcohol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Benzyl Alcohol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Benzyl chloride	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Benzyl chloride	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Beryllium	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	5	0
Beryllium	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	3	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Beryllium, filtered	PPB	3-8-1	4/12/90 <	5.00	5.00	5.00	5.00	5	0
Beryllium, filtered	PPB	3-8-2	6/13/89 <	5.00	5.00	5.00	5.00	3	0
Beta-BHC	PPB	3-8-1	4/12/90 <	.10	.10	.10	.10	7	0
Beta-BHC	PPB	3-8-2	6/13/89 <	.10	.79	1.00	.10	21	0
Bicarbonate	MG/L	3-6-1	12/29/77	140.00	142.86	160.00	140.00	7	7
Bicarbonate	MG/L	3-8-1	12/29/77	120.00	117.00	120.00	100.00	10	10
Bicarbonate	MG/L	3-8-2	12/29/77	130.00	129.00	140.00	120.00	10	10
Bis(2-chloro-1-methylethyl)ether	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	2	0
Bis(2-chloro-1-methylethyl)ether	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	1	0
Bis(2-chloroethoxy) methane	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Bis(2-chloroethoxy) methane	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Bis(2-chloroethyl) ether	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Bis(2-chloroethyl) ether	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Bis(2-chloroisopropyl)ether	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Bis(2-chloroisopropyl)ether	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Bis(2-ethylhexyl) phthalate	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Bis(2-ethylhexyl) phthalate	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Bis(chloromethyl) ether	PPB	3-8-1	4/12/90 <	5.00	6.67	10.00	5.00	3	0
Bis(chloromethyl) ether	PPB	3-8-2	6/13/89 <	5.00	7.50	10.00	5.00	2	0
Boron	PPB	3-8-1	4/12/90	31.00	26.33	31.00	18.00	3	3
Boron	PPB	3-8-2	6/13/89	20.00	20.00	20.00	20.00	1	1
Boron, filtered	PPB	3-8-1	4/12/90	33.00	27.67	33.00	18.00	3	3
Boron, filtered	PPB	3-8-2	6/13/89	25.00	25.00	25.00	25.00	1	1
Bromide	PPB	3-8-1	5/23/90 <	1000.00	1000.00	1000.00	1000.00	4	0
Bromide	PPB	3-8-2	6/13/89 <	1000.00	1000.00	1000.00	1000.00	1	0
Bromoacetone	PPB	3-8-1	4/12/90 <	5.00	6.67	10.00	5.00	3	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Bromoacetone	PPB	3-8-2	6/13/89	< 5.00	7.50	10.00	5.00	2	0
Bromodichloromethane	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	2	0
Bromodichloromethane	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	1	0
Bromoform	PPB	3-8-1	4/12/90	< 5.00	6.67	10.00	5.00	3	0
Bromoform	PPB	3-8-2	6/13/89	< 5.00	7.50	10.00	5.00	2	0
Butyl benzyl phthalate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Butyl benzyl phthalate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Cadmium	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	7	0
Cadmium	PPB	3-8-2	6/13/89	< 2.00	2.03	3.00	2.00	29	1
Cadmium, filtered	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	7	0
Cadmium, filtered	PPB	3-8-2	6/13/89	< 2.00	2.00	2.00	2.00	15	1
Calcium	PPB	3-8-1	4/12/90	41600.00	41100.00	43900.00	37400.00	7	7
Calcium	PPB	3-8-2	6/13/89	41900.00	41750.00	46500.00	36300.00	16	16
Calcium, filtered	PPB	3-8-1	4/12/90	39500.00	42442.86	46000.00	37900.00	7	7
Calcium, filtered	PPB	3-8-2	6/13/89	38400.00	41700.00	45100.00	36100.00	15	15
Carbon Tetrachloride by GC/MS	PPB	3-8-1	5/23/90	< 5.00	5.00	5.00	5.00	8	0
Carbon Tetrachloride by GC/MS	PPB	3-8-2	6/13/89	< 5.00	8.24	10.00	2.00	29	0
Carbon disulfide	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Carbon disulfide	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Carbonate	MG/L	3-6-1	12/29/77	0.00	.43	1.00	0.00	7	3
Carbonate	MG/L	3-8-1	12/29/77	0.00	.50	1.00	0.00	10	5
Carbonate	MG/L	3-8-2	12/29/77	0.00	.50	1.00	0.00	10	5
Carbophenothion	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	3	0
Carbophenothion	PPB	3-8-2	6/13/89	< 2.00	2.00	2.00	2.00	2	0
Cesium-137	PCI/L	3-6-1	11/29/88	< 2.47	2.22	12.00	-7.03	17	0
Cesium-137	PCI/L	3-8-1	4/12/90	< 1.21	2.09	10.30	-2.47	10	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Cesium-137	PCI/L	3-8-2	10/19/87	< -3.79	7.97	31.00	-3.79	9	2
Cesium-137	PCI/L	3-8-4	10/19/87	< 6.41	9.28	31.00	-3.03	5	1
Chemical calcium by AA	MG/L	3-6-1	12/29/77	40.00	37.43	44.00	19.00	7	7
Chemical calcium by AA	MG/L	3-8-1	12/29/77	30.00	28.40	37.00	17.00	10	10
Chemical calcium by AA	MG/L	3-8-2	12/29/77	38.00	27.50	40.00	17.00	10	10
Chemical sodium by AA	MG/L	3-6-1	12/29/77	24.00	19.14	24.00	16.00	7	7
Chemical sodium by AA	MG/L	3-8-1	12/29/77	15.00	13.30	22.00	9.50	10	10
Chemical sodium by AA	MG/L	3-8-2	12/29/77	20.00	18.10	21.00	14.00	10	10
Chlordane	PPB	3-8-1	4/12/90	< 1.00	1.00	1.00	1.00	3	0
Chlordane	PPB	3-8-2	6/13/89	< 1.00	1.00	1.00	1.00	2	0
Chloride	PPB	3-6-1	7/15/86	16400.00	16400.00	16400.00	16400.00	1	1
Chloride	PPB	3-8-1	5/23/90	1000.00	8977.78	13300.00	1000.00	9	9
Chloride	PPB	3-8-2	6/13/89	9900.00	9647.60	14700.00	978.00	30	30
Chloride	PPB	3-8-4	7/15/86	12600.00	12600.00	12600.00	12600.00	1	1
Chloride by chemical analysis	MG/L	3-6-1	12/29/77	10.00	10.09	11.00	9.30	7	7
Chloride by chemical analysis	MG/L	3-8-1	12/29/77	4.80	5.16	6.50	4.00	10	10
Chloride by chemical analysis	MG/L	3-8-2	12/29/77	6.80	6.20	7.50	5.00	10	10
Chlornaphazine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Chlornaphazine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Chloroacetaldehyde	PPB	3-8-1	5/10/88	< 16000.00	16000.00	16000.00	16000.00	1	0
Chloroacetaldehyde	PPB	3-8-2	5/10/88	< 16000.00	16000.00	16000.00	16000.00	1	0
Chloroalkyl ethers	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Chloroalkyl ethers	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Chlorobenzene	PPB	3-8-1	4/12/90	< 5.00	6.67	10.00	5.00	3	0
Chlorobenzene	PPB	3-8-2	6/13/89	< 5.00	7.50	10.00	5.00	2	0
Chlorobenzene (by ABN)	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Chlorobenzene (by ABN)	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS			CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling		Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Chlorobenzilate	PPB	3-8-1	4/12/90	<	300.00	210.00	300.00	30.00	3	0
Chlorobenzilate	PPB	3-8-2	6/13/89	<	300.00	118.57	300.00	30.00	7	0
Chloroethane	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	2	0
Chloroethane	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	1	0
Chloroform	PPB	3-8-1	5/23/90	<	5.00	5.00	5.00	5.00	8	0
Chloroform	PPB	3-8-2	6/13/89	<	5.00	8.44	10.00	5.00	16	0
Chloromethyl methyl ether	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
Chloromethyl methyl ether	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
Chromium	PPB	3-8-1	4/12/90	<	10.00	10.43	13.00	10.00	7	1
Chromium	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	29	0
Chromium, filtered	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	7	0
Chromium, filtered	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	15	0
Chromium-6	MG/L	3-6-1	10/10/86		.00	.01	.03	.00	84	70
Chromium-6	MG/L	3-8-1	10/10/86		.00	.01	.04	.00	50	38
Chromium-6	MG/L	3-8-2	10/22/86		.00	.00	.02	.00	71	55
Chromium-6	MG/L	3-8-4	10/10/86		.00	.00	.01	0.00	42	31
Chrysene	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
Chrysene	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
Citrus red	PPB	3-8-1	4/12/90	<	1000.00	1000.00	1000.00	1000.00	3	0
Citrus red	PPB	3-8-2	6/13/89	<	1000.00	1000.00	1000.00	1000.00	2	0
Cobalt	PPB	3-8-1	4/12/90	<	20.00	20.00	20.00	20.00	3	0
Cobalt	PPB	3-8-2	6/13/89	<	20.00	20.00	20.00	20.00	1	0
Cobalt, filtered	PPB	3-8-1	4/12/90	<	20.00	20.00	20.00	20.00	3	0
Cobalt, filtered	PPB	3-8-2	6/13/89	<	20.00	20.00	20.00	20.00	1	0
Cobalt-60	PCI/L	3-6-1	11/29/88	<	-2.65	6.86	39.00	-9.90	37	2
Cobalt-60	PCI/L	3-8-1	4/12/90	<	-3.21	4.45	26.00	-7.00	27	0
Cobalt-60	PCI/L	3-8-2	10/19/87	<	3.39	9.11	37.00	-14.00	28	4

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Cobalt-60	PCI/L	3-8-4	10/19/87	< 2.80	5.73	36.00	-11.00	21	2
Coliform (Membrane Filter)	PPB	3-8-1	5/23/90	< 1.00	800.67	2400.00	1.00	3	1
Coliform bacteria	MPN	3-8-1	6/05/89	< 2.20	2.20	2.20	2.20	5	0
Coliform bacteria	MPN	3-8-2	6/13/89	< 2.20	4.23	16.00	2.20	29	4
Conductivity, Laboratory	UMHO	3-8-1	4/12/90	360.00	360.00	360.00	360.00	1	1
Copper	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	7	0
Copper	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	29	0
Copper by chemical analysis	MG/L	3-6-1	1/27/77	.05	.05	.05	.05	1	0
Copper by chemical analysis	MG/L	3-8-1	1/28/77	.05	.05	.05	.05	1	0
Copper by chemical analysis	MG/L	3-8-2	1/26/77	.05	.05	.05	.05	1	0
Copper, filtered	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	7	0
Copper, filtered	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	15	0
Cresols	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Cresols	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Crotonaldehyde	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Crotonaldehyde	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Cyanide	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	4	0
Cyanide	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	27	0
DDD	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	3	0
DDD	PPB	3-8-2	6/13/89	< .10	.10	.10	.10	2	0
DDE	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	3	0
DDE	PPB	3-8-2	6/13/89	< .10	.10	.10	.10	2	0
DDT	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	3	0
DDT	PPB	3-8-2	6/13/89	< .10	.10	.10	.10	2	0
Delta-BHC	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	7	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Delta-BHC	PPB	3-8-2	6/13/89	< .10	.79	1.00	.10	21	0
Di-n-butyl phthalate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Di-n-butyl phthalate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Di-n-octyl phthalate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Di-n-octyl phthalate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Di-n-propylnitrosamine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Di-n-propylnitrosamine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Diallate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Diallate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Dibenz[a,h]acridine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dibenz[a,h]acridine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dibenz[a,h]anthracene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dibenz[a,h]anthracene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dibenz[a,j]acridine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dibenz[a,j]acridine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dibenzo[a,e]pyrene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dibenzo[a,e]pyrene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dibenzo[a,h]pyrene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dibenzo[a,h]pyrene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dibenzo[a,i]pyrene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dibenzo[a,i]pyrene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dibenzofuran	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Dibenzofuran	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Dibromomethane	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dibromomethane	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Dibutyl Phosphate	PPB	3-8-1	4/12/90	< 10000.00	10000.00	10000.00	10000.00	2	0
Dibutyl Phosphate	PPB	3-8-2	6/13/89	< 10000.00	10000.00	10000.00	10000.00	1	0
Dichlorodifluoromethane	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dichlorodifluoromethane	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dieldrin	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	3	0
Dieldrin	PPB	3-8-2	6/13/89	< .10	.10	.10	.10	2	0
Diethyl phthalate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Diethyl phthalate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Diethylarsine	PPB	3-8-1	5/10/88	< 10.00	10.00	10.00	10.00	1	0
Diethylarsine	PPB	3-8-2	5/10/88	< 10.00	10.00	10.00	10.00	1	0
Diethylstilbesterol	PPB	3-8-1	4/12/90	< 200.00	200.00	200.00	200.00	3	0
Diethylstilbesterol	PPB	3-8-2	6/13/89	< 200.00	200.00	200.00	200.00	2	0
Dihydrosafrole	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dihydrosafrole	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dimethoate	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	3	0
Dimethoate	PPB	3-8-2	6/13/89	< 2.00	2.00	2.00	2.00	2	0
Dimethyl phthalate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dimethyl phthalate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dinitrobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Dinitrobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Dinoseb	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Dinoseb	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Dioxane	PPB	3-8-1	4/12/90	< 500.00	500.00	500.00	500.00	3	0
Dioxane	PPB	3-8-2	6/13/89	< 500.00	500.00	500.00	500.00	15	0
Dioxin	PPB	3-8-1	5/10/88	< .10	.10	.10	.10	1	0
Dioxin	PPB	3-8-2	5/10/88	< .10	.10	.10	.10	12	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Diphenylamine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Diphenylamine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Disulfoton	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	3	0
Disulfoton	PPB	3-8-2	6/13/89	< 2.00	2.00	2.00	2.00	2	0
Endosulfan I	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	3	0
Endosulfan I	PPB	3-8-2	6/13/89	< .10	.10	.10	.10	2	0
Endosulfan II	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	3	0
Endosulfan II	PPB	3-8-2	6/13/89	< .10	.10	.10	.10	2	0
Endosulfan Sulfate	PPB	3-8-1	4/12/90	< .50	.50	.50	.50	2	0
Endosulfan Sulfate	PPB	3-8-2	6/13/89	< .50	.50	.50	.50	1	0
Endrin	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	7	0
Endrin	PPB	3-8-2	6/13/89	< .10	.79	1.00	.10	21	0
Ethanol	PPB	3-8-1	4/12/90	< 10000.00	10000.00	10000.00	10000.00	2	0
Ethanol	PPB	3-8-2	6/13/89	< 10000.00	10000.00	10000.00	10000.00	1	0
Ethyl benzene	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	2	0
Ethyl benzene	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	1	0
Ethyl carbamate	PPB	3-8-1	4/12/90	< 10000.00	8333.33	10000.00	5000.00	3	0
Ethyl carbamate	PPB	3-8-2	6/13/89	< 10000.00	7500.00	10000.00	5000.00	2	0
Ethyl cyanide	PPB	3-8-1	4/12/90	< 10000.00	7333.33	10000.00	2000.00	3	0
Ethyl cyanide	PPB	3-8-2	6/13/89	< 10000.00	6000.00	10000.00	2000.00	2	0
Ethyl methacrylate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Ethyl methacrylate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Ethyl methanesulfonate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Ethyl methanesulfonate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Ethylene Glycol	PPB	3-8-1	4/12/90	< 10000.00	10000.00	10000.00	10000.00	2	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Ethylene Glycol	PPB	3-8-2	6/13/89	< 10000.00	10000.00	10000.00	10000.00	1	0
Ethylene glycol	PPB	3-8-1	5/10/88	< 10000.00	10000.00	10000.00	10000.00	1	0
Ethylene glycol	PPB	3-8-2	5/10/88	< 10000.00	10000.00	10000.00	10000.00	12	0
Ethylene oxide	PPB	3-8-1	4/12/90	< 10.00	1006.67	3000.00	10.00	3	0
Ethylene oxide	PPB	3-8-2	6/13/89	< 10.00	1505.00	3000.00	10.00	2	0
Ethyleneimine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Ethyleneimine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Ethylenethiourea	PPB	3-8-1	4/12/90	< 200.00	200.00	200.00	200.00	3	0
Ethylenethiourea	PPB	3-8-2	6/13/89	< 200.00	200.00	200.00	200.00	2	0
Fluoranthene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Fluoranthene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Fluorene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Fluorene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Fluoride	MG/L	3-6-1	10/10/86	.29	6.41	500.00	.10	83	82
Fluoride	PPB	3-8-1	5/23/90	< 500.00	66.52	500.00	.01	68	57
Fluoride	PPB	3-8-2	6/13/89	< 500.00	138.36	552.00	.05	109	79
Fluoride	MG/L	3-8-4	10/10/86	.32	11.91	500.00	.20	43	42
Formalin	PPB	3-8-1	4/12/90	< 500.00	500.00	500.00	500.00	3	0
Formalin	PPB	3-8-2	6/13/89	< 500.00	500.00	500.00	500.00	15	0
Gamma-BHC	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	7	0
Gamma-BHC	PPB	3-8-2	6/13/89	< .10	.79	1.00	.10	21	0
Gross alpha	PCI/L	3-6-1	12/29/77	6.00	6.59	8.10	4.30	7	7
Gross alpha	PCI/L	3-8-1	12/09/88	1.76	5.74	23.00	.83	14	8
Gross alpha	PCI/L	3-8-2	12/09/88	1.84	1.96	3.56	.31	38	0
Gross beta	PCI/L	3-6-1	11/29/88	9.36	54.95	420.00	.10	78	62
Gross beta	PCI/L	3-8-1	4/12/90	5.23	44.26	200.00	-2.50	82	56
Gross beta	PCI/L	3-8-2	6/13/89	5.60	46.70	610.00	-9.60	110	87

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Gross beta	PCI/L	3-8-4	12/12/88	4.92	57.24	75.00	-3.70	47	39
Hardness	MG/L	3-6-1	12/29/77	140.00	128.57	140.00	80.00	7	7
Hardness	MG/L	3-8-1	12/29/77	110.00	87.62	120.00	1.20	10	10
Hardness	MG/L	3-8-2	12/29/77	130.00	97.90	130.00	73.00	10	10
Heptachlor	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	3	0
Heptachlor	PPB	3-8-2	6/13/89	< .10	.10	.10	.10	2	0
Heptchlor epoxide	PPB	3-8-1	4/12/90	< .10	.10	.10	.10	3	0
Heptchlor epoxide	PPB	3-8-2	6/13/89	< .10	.10	.10	.10	2	0
Hexachlorobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Hexachlorobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	14	0
Hexachlorobutadiene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Hexachlorobutadiene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Hexachlorocyclopentadiene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Hexachlorocyclopentadiene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Hexachloroethane	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Hexachloroethane	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Hexachlorophene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Hexachlorophene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	14	0
Hexachloropropene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Hexachloropropene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	9	0
Hydrazine	PPB	3-8-1	5/10/88	< 3000.00	3000.00	3000.00	3000.00	1	0
Hydrazine	PPB	3-8-2	5/10/88	< 3000.00	3000.00	3000.00	3000.00	1	0
Hydrazine, Low Detection Level	PPB	3-8-1	4/12/90	< 30.00	30.00	30.00	30.00	2	0
Hydrazine, Low Detection Level	PPB	3-8-2	6/13/89	< 30.00	30.00	30.00	30.00	1	0
Hydrogen sulfide	PPB	3-8-1	5/10/88	< 10.00	10.00	10.00	10.00	1	0
Hydrogen sulfide	PPB	3-8-2	5/10/88	< 10.00	10.00	10.00	10.00	1	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Indeno(1,2,3-cd)pyrene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Indeno(1,2,3-cd)pyrene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Iodomethane	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Iodomethane	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Iron	PPB	3-8-1	4/12/90	118.00	159.71	437.00	30.00	7	5
Iron	PPB	3-8-2	6/13/89	77.00	82.79	557.00	30.00	29	13
Iron, filtered	PPB	3-8-1	4/12/90	< 30.00	36.86	74.00	30.00	7	2
Iron, filtered	PPB	3-8-2	6/13/89	< 30.00	43.40	50.00	30.00	15	1
Isobutyl alcohol	PPB	3-8-1	4/12/90	< 10000.00	7000.00	10000.00	1000.00	3	0
Isobutyl alcohol	PPB	3-8-2	6/13/89	< 10000.00	5500.00	10000.00	1000.00	2	0
Isodrin	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Isodrin	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Isophorone	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Isophorone	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Isosafrole	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Isosafrole	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Kepone	PPB	3-8-1	4/12/90	< 1.00	1.00	1.00	1.00	2	0
Kepone	PPB	3-8-2	6/13/89	< 1.00	1.00	1.00	1.00	1	0
Kerosene	PPB	3-8-1	4/12/90	< 10000.00	10000.00	10000.00	10000.00	3	0
Kerosene	PPB	3-8-2	6/13/89	< 10000.00	10000.00	10000.00	10000.00	14	0
Lead	PPB	3-8-2	12/05/85	< 30.00	55.50	168.00	30.00	6	2
Lead (graphite furnace)	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	7	0
Lead (graphite furnace)	PPB	3-8-2	6/13/89	< 5.00	5.37	14.00	5.00	29	5
Lead, filtered	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	7	0
Lead, filtered	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	15	1

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Lithium	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Lithium	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	1	0
Lithium, filtered	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Lithium, filtered	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	1	0
Magnesium	PPB	3-8-1	4/12/90	8490.00	8687.14	9130.00	7920.00	7	7
Magnesium	PPB	3-8-2	6/13/89	8620.00	8968.13	9580.00	8400.00	16	16
Magnesium by chemical analysis	MG/L	3-6-1	12/29/77	9.00	8.50	9.30	8.00	7	7
Magnesium by chemical analysis	MG/L	3-8-1	12/29/77	8.80	7.37	9.40	6.40	10	10
Magnesium by chemical analysis	MG/L	3-8-2	12/29/77	8.30	6.98	8.30	4.80	10	10
Magnesium, filtered	PPB	3-8-1	4/12/90	8320.00	9052.86	9930.00	7890.00	7	7
Magnesium, filtered	PPB	3-8-2	6/13/89	7860.00	8928.67	9540.00	7860.00	15	15
Maleic hydrizide	PPB	3-8-1	4/12/90 <	500.00	500.00	500.00	500.00	3	0
Maleic hydrizide	PPB	3-8-2	6/13/89 <	500.00	500.00	500.00	500.00	7	0
Malononitrile	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Malononitrile	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Manganese	PPB	3-8-1	4/12/90 <	5.00	5.00	5.00	5.00	7	0
Manganese	PPB	3-8-2	6/13/89 <	5.00	5.07	7.00	5.00	29	2
Manganese, filtered	PPB	3-8-1	4/12/90 <	5.00	5.00	5.00	5.00	7	0
Manganese, filtered	PPB	3-8-2	6/13/89 <	5.00	5.00	5.00	5.00	15	0
Melphalan	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	3	0
Melphalan	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	2	0
Mercury	PPB	3-8-1	4/12/90 <	.10	.10	.10	.10	7	0
Mercury	PPB	3-8-2	6/13/89 <	.10	.10	.10	.10	29	0
Mercury, filtered	PPB	3-8-1	4/12/90 <	.10	.10	.10	.10	7	0
Mercury, filtered	PPB	3-8-2	6/13/89 <	.10	.10	.10	.10	15	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Methacrylonitrile	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Methacrylonitrile	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Methanethiol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Methanethiol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Methapyrilene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Methapyrilene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Metholonyl	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Metholonyl	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Methoxychlor	PPB	3-8-1	4/12/90	< 3.00	3.00	3.00	3.00	7	0
Methoxychlor	PPB	3-8-2	6/13/89	< 3.00	1.48	3.00	1.00	21	0
Methyl Isobutyl Ketone	PPB	3-8-1	5/23/90	< 10.00	10.00	10.00	10.00	8	0
Methyl Isobutyl Ketone	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	5	0
Methyl bromide	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Methyl bromide	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Methyl chloride	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Methyl chloride	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Methyl ethyl ketone	PPB	3-8-1	5/23/90	< 10.00	10.00	10.00	10.00	8	0
Methyl ethyl ketone	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	29	0
Methyl methacrylate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Methyl methacrylate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Methyl methanesulfonate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Methyl methanesulfonate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Methyl parathion	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	3	0
Methyl parathion	PPB	3-8-2	6/13/89	< 2.00	2.00	2.00	2.00	2	0
Methylene Chloride	PPB	3-8-1	5/23/90	< 5.00	7.50	10.00	5.00	8	0
Methylene Chloride	PPB	3-8-2	6/13/89	< 5.00	90.05	820.00	5.00	20	4

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS			CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling		Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Methylthiouracil	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
Methylthiouracil	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
Molybdenum	PPB	3-8-1	4/12/90	<	40.00	40.00	40.00	40.00	3	0
Molybdenum	PPB	3-8-2	6/13/89	<	40.00	40.00	40.00	40.00	1	0
Molybdenum, filtered	PPB	3-8-1	4/12/90	<	40.00	40.00	40.00	40.00	3	0
Molybdenum, filtered	PPB	3-8-2	6/13/89	<	40.00	40.00	40.00	40.00	1	0
Monobutyl Phosphate	PPB	3-8-1	4/12/90	<	10000.00	10000.00	10000.00	10000.00	2	0
Monobutyl Phosphate	PPB	3-8-2	6/13/89	<	10000.00	10000.00	10000.00	10000.00	1	0
N,N-diethylhydrazine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
N,N-diethylhydrazine	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
N-Nitrosodiphenylamine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	2	0
N-Nitrosodiphenylamine	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	1	0
N-nitroso-N-methylurethane	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
N-nitroso-N-methylurethane	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
N-nitrosodi-n-butylamine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
N-nitrosodi-n-butylamine	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
N-nitrosodiethanolamine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
N-nitrosodiethanolamine	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
N-nitrosodiethylamine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
N-nitrosodiethylamine	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
N-nitrosodimethylamine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
N-nitrosodimethylamine	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
N-nitrosomethylethylamine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0
N-nitrosomethylethylamine	PPB	3-8-2	6/13/89	<	10.00	10.00	10.00	10.00	2	0
N-nitrosomethylvinylamine	PPB	3-8-1	4/12/90	<	10.00	10.00	10.00	10.00	3	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
N-nitrosomethylvinylamine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
N-nitrosomorpholine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
N-nitrosomorpholine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
N-nitrosonornicotine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
N-nitrosonornicotine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
N-nitrosopiperidine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
N-nitrosopiperidine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
N-phenylthiourea	PPB	3-8-1	4/12/90	< 500.00	500.00	500.00	500.00	3	0
N-phenylthiourea	PPB	3-8-2	6/13/89	< 500.00	500.00	500.00	500.00	2	0
N-propylamine	PPB	3-8-1	4/12/90	< 10000.00	10000.00	10000.00	10000.00	3	0
N-propylamine	PPB	3-8-2	6/13/89	< 10000.00	10000.00	10000.00	10000.00	2	0
Naphthalene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Naphthalene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	14	0
Nickel	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	7	0
Nickel	PPB	3-8-2	6/13/89	< 10.00	10.24	17.00	10.00	29	1
Nickel, filtered	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	7	0
Nickel, filtered	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	15	0
Nicotinic acid	PPB	3-8-1	4/12/90	< 100.00	100.00	100.00	100.00	3	0
Nicotinic acid	PPB	3-8-2	6/13/89	< 100.00	100.00	100.00	100.00	7	0
Nitrate	PPB	3-6-1	4/02/87	28100.00	28033.33	29300.00	24900.00	6	6
Nitrate	PPB	3-8-1	5/23/90	1500.00	17333.33	21900.00	1500.00	12	12
Nitrate	PPB	3-8-2	6/13/89	21600.00	21072.73	24600.00	16000.00	33	33
Nitrate	PPB	3-8-4	5/06/87	26500.00	24666.67	26500.00	22300.00	3	3
Nitrate, High Detection Level	PPB	3-6-1	11/29/88	32400.00	29550.00	32700.00	27000.00	8	8
Nitrate, High Detection Level	PPB	3-8-1	12/20/89	20300.00	18775.00	21000.00	14800.00	8	8
Nitrate, High Detection Level	PPB	3-8-4	12/12/88	22300.00	21716.67	23100.00	19500.00	6	6

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Nitrate, Phenodisulfonic Acid Met	MG/L	3-6-1	12/02/83	19.00	11.34	27.00	.29	75	74
Nitrate, Phenodisulfonic Acid Met	MG/L	3-8-1	12/02/83	8.40	6.05	71.00	.33	45	42
Nitrate, Phenodisulfonic Acid Met	MG/L	3-8-2	12/02/83	8.90	6.74	12.00	1.80	62	62
Nitrate, Phenodisulfonic Acid Met	MG/L	3-8-4	2/06/84	13.00	8.41	13.00	6.00	30	30
Nitrate-Ion	MG/L	3-6-1	4/28/86	54.00	48.30	100.00	29.00	10	10
Nitrate-Ion	MG/L	3-8-1	4/28/86	26.00	26.60	55.00	15.00	10	10
Nitrate-Ion	MG/L	3-8-2	4/18/86	40.00	37.90	120.00	17.00	10	10
Nitrate-Ion	MG/L	3-8-4	4/24/86	38.00	40.67	95.00	22.00	9	9
Nitrite	PPB	3-8-1	5/23/90	< 1000.00	1000.00	1000.00	1000.00	4	0
Nitrite	PPB	3-8-2	6/13/89	< 1000.00	1000.00	1000.00	1000.00	1	0
Nitrobenzine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Nitrobenzine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Nitrosopyrrolidine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Nitrosopyrrolidine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
O,O,O-triethyl phosphorothioate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
O,O,O-triethyl phosphorothioate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
O-toluidine hydrochloride	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
O-toluidine hydrochloride	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
P benzoquinone	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
P benzoquinone	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
P-chloro-m-cresol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
P-chloro-m-cresol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
P-chloroaniline	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
P-chloroaniline	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
P-dimethylaminoazobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
P-dimethylaminoazobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
P-nitroaniline	PPB	3-8-1	4/12/90	< 10.00	23.33	50.00	10.00	3	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
P-nitroaniline	PPB	3-8-2	6/13/89	< 10.00	30.00	50.00	10.00	2	0
PHORATE	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	2	0
PHORATE	PPB	3-8-2	6/13/89	< 2.00	2.00	2.00	2.00	1	0
Paraldehyde	PPB	3-8-1	4/12/90	< 10000.00	7333.33	10000.00	2000.00	3	0
Paraldehyde	PPB	3-8-2	6/13/89	< 10000.00	6000.00	10000.00	2000.00	2	0
Parathion	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	3	0
Parathion	PPB	3-8-2	6/13/89	< 2.00	2.00	2.00	2.00	2	0
Pcdd's	PPB	3-8-1	4/12/90	< .01	.01	.01	.01	2	0
Pcdd's	PPB	3-8-2	6/13/89	< .01	.01	.01	.01	1	0
Pcdf's	PPB	3-8-1	4/12/90	< .01	.01	.01	.01	2	0
Pcdf's	PPB	3-8-2	6/13/89	< .01	.01	.01	.01	1	0
Pentachlorobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Pentachlorobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	14	0
Pentachloroethane	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Pentachloroethane	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Pentachloronitrobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Pentachloronitrobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Pentachlorophenol	PPB	3-8-1	4/12/90	< 50.00	50.00	50.00	50.00	3	0
Pentachlorophenol	PPB	3-8-2	6/13/89	< 50.00	50.00	50.00	50.00	2	0
Perchlorate	PPB	3-8-1	4/12/90	< 500.00	750.00	1000.00	500.00	2	0
Perchlorate	PPB	3-8-2	5/10/88	< 1000.00	1000.00	1000.00	1000.00	1	0
Phenacetin	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Phenacetin	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Phenanthrene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Phenanthrene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Phenol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Phenol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	14	0
Phenol, low DL	PPB	3-8-1	12/20/89	< 10.00	10.00	10.00	10.00	4	0
Phenol, low DL	PPB	3-8-2	12/09/88	< 10.00	4.42	10.00	1.00	6	0
Phenylenediamine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Phenylenediamine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Phosphate	PPB	3-6-1	7/15/86	< 1000.00	1000.00	1000.00	1000.00	1	0
Phosphate	PPB	3-8-1	5/23/90	< 1000.00	1000.00	1000.00	1000.00	9	0
Phosphate	PPB	3-8-2	6/13/89	< 1000.00	1000.00	1000.00	1000.00	30	0
Phosphate	PPB	3-8-4	7/15/86	< 1000.00	1000.00	1000.00	1000.00	1	0
Phthalic acid esters	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Phthalic acid esters	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Potassium	PPB	3-8-1	4/12/90	4990.00	4948.57	5260.00	4600.00	7	7
Potassium	PPB	3-8-2	6/13/89	5210.00	5310.34	6550.00	4520.00	29	29
Potassium, filtered	PPB	3-8-1	4/12/90	4890.00	5091.43	5500.00	4490.00	7	7
Potassium, filtered	PPB	3-8-2	6/13/89	4700.00	5232.67	5500.00	4700.00	15	15
Pronamide	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Pronamide	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Propionitrile	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	2	0
Propionitrile	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	1	0
Pyrene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	2	0
Pyrene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Pyridine	PPB	3-8-1	4/12/90	< 500.00	500.00	500.00	500.00	3	0
Pyridine	PPB	3-8-2	6/13/89	< 500.00	500.00	500.00	500.00	15	0
Radium	PCI/L	3-8-1	4/12/90	< -.03	.03	.17	-.03	7	0
Radium	PCI/L	3-8-2	6/13/89	.16	.08	.38	-.10	29	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Reserpine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Reserpine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Resorcinol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Resorcinol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Ruthenium-106	PCI/L	3-6-1	11/29/88	< -17.80	23.90	160.00	-53.90	16	0
Ruthenium-106	PCI/L	3-8-1	4/12/90	< -21.50	29.24	110.00	-21.50	12	0
Ruthenium-106	PCI/L	3-8-2	10/19/87	< -43.50	48.52	210.00	-43.50	9	1
Ruthenium-106	PCI/L	3-8-4	10/19/87	< 7.18	2.94	11.30	-9.66	3	0
Safrol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Safrol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Selenium	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	7	0
Selenium	PPB	3-8-2	6/13/89	< 5.00	5.24	12.00	5.00	29	1
Selenium, filtered	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	7	0
Selenium, filtered	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	15	0
Silicon	PPB	3-8-1	4/12/90	16500.00	16200.00	16500.00	15600.00	3	3
Silicon	PPB	3-8-2	6/13/89	16300.00	16300.00	16300.00	16300.00	1	1
Silicon, filtered	PPB	3-8-1	4/12/90	16000.00	16000.00	16500.00	15500.00	3	3
Silicon, filtered	PPB	3-8-2	6/13/89	15000.00	15000.00	15000.00	15000.00	1	1
Silver	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	7	0
Silver	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	29	0
Silver, filtered	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	7	0
Silver, filtered	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	15	0
Sodium	PPB	3-8-1	4/12/90	14600.00	13700.00	15400.00	12500.00	7	7
Sodium	PPB	3-8-2	6/13/89	18400.00	18593.10	20300.00	16600.00	29	29
Sodium, filtered	PPB	3-8-1	4/12/90	14400.00	14314.29	15900.00	12300.00	7	7
Sodium, filtered	PPB	3-8-2	6/13/89	16800.00	18380.00	19400.00	16800.00	15	15

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Specific conductance	UMHO	3-6-1	12/29/77	350.00	367.14	400.00	350.00	7	7
Specific conductance	UMHO	3-8-1	5/23/90	360.00	315.44	360.00	250.00	18	18
Specific conductance	UMHO	3-8-2	6/13/89	335.00	340.03	402.00	266.00	37	37
Strontium	PPB	3-8-1	4/12/90	173.00	171.40	191.00	159.00	5	5
Strontium	PPB	3-8-2	6/13/89	189.00	187.67	197.00	177.00	3	3
Strontium, filtered	PPB	3-8-1	4/12/90	168.00	172.80	191.00	159.00	5	5
Strontium, filtered	PPB	3-8-2	6/13/89	173.00	182.33	189.00	173.00	3	3
Strychnine	PPB	3-8-1	4/12/90	< 50.00	50.00	50.00	50.00	3	0
Strychnine	PPB	3-8-2	6/13/89	< 50.00	50.00	50.00	50.00	7	0
Styrene	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	2	0
Styrene	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	1	0
Sulfate	PPB	3-6-1	7/15/86	34600.00	34600.00	34600.00	34600.00	1	1
Sulfate	PPB	3-8-1	5/23/90	2900.00	25944.44	32800.00	2900.00	9	9
Sulfate	PPB	3-8-2	6/13/89	29700.00	28926.67	31200.00	25000.00	30	30
Sulfate	PPB	3-8-4	7/15/86	30300.00	30300.00	30300.00	30300.00	1	1
Sulfide	PPB	3-8-1	4/12/90	< 1000.00	1000.00	1000.00	1000.00	3	0
Sulfide	PPB	3-8-2	6/13/89	< 1000.00	1053.08	2380.00	1000.00	26	1
Sulphate	MG/L	3-6-1	12/29/77	8.50	9.43	10.00	8.50	7	7
Sulphate	MG/L	3-8-1	12/29/77	7.00	7.06	9.60	5.50	10	10
Sulphate	MG/L	3-8-2	12/29/77	7.50	7.35	9.00	5.50	10	10
Sym-trinitrobenzene	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Sym-trinitrobenzene	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Technetium-99	PCI/L	3-6-1	3/01/89	< -.36	2.15	4.73	-.36	3	0
Technetium-99	PCI/L	3-8-1	12/20/89	< 1.51	.63	1.51	-.22	4	0
Technetium-99	PCI/L	3-8-4	7/08/88	< .99	1.34	1.69	.99	2	0
Tetrachloroethylene	PPB	3-8-1	5/23/90	< 5.00	5.00	5.00	5.00	8	0
Tetrachloroethylene	PPB	3-8-2	6/13/89	< 5.00	10.00	42.00	4.00	29	3

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Tetraethylpyrophosphate	PPB	3-8-1	4/12/90	< 2.00	2.00	2.00	2.00	2	0
Tetraethylpyrophosphate	PPB	3-8-2	6/13/89	< 2.00	2.00	2.00	2.00	2	0
Tetrahydrofuran	PPB	3-8-1	5/23/90	< 10.00	10.00	10.00	10.00	4	0
Tetrahydrofuran	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	1	0
Thallium	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	3	0
Thallium	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	2	0
Thallium, filtered	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	3	0
Thallium, filtered	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	2	0
Thiofanox	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Thiofanox	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Thiourea	PPB	3-8-1	4/12/90	< 200.00	200.00	200.00	200.00	3	0
Thiourea	PPB	3-8-2	6/13/89	< 200.00	200.00	200.00	200.00	13	0
Thiuram	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Thiuram	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Tin	PPB	3-8-1	4/12/90	< 30.00	30.00	30.00	30.00	3	0
Tin	PPB	3-8-2	6/13/89	< 30.00	30.00	30.00	30.00	1	0
Tin, filtered	PPB	3-8-1	4/12/90	< 30.00	30.00	30.00	30.00	3	0
Tin, filtered	PPB	3-8-2	6/13/89	< 30.00	30.00	30.00	30.00	1	0
Titanium	PPB	3-8-1	4/12/90	< 60.00	60.00	60.00	60.00	3	0
Titanium	PPB	3-8-2	6/13/89	< 60.00	60.00	60.00	60.00	1	0
Titanium, filtered	PPB	3-8-1	4/12/90	< 60.00	60.00	60.00	60.00	3	0
Titanium, filtered	PPB	3-8-2	6/13/89	< 60.00	60.00	60.00	60.00	1	0
Toluene	PPB	3-8-1	5/23/90	< 5.00	5.00	5.00	5.00	5	0
Toluene	PPB	3-8-2	6/13/89	< 5.00	9.33	10.00	5.00	15	0
Toluenediamine	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Toluenediamine	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Total Organic Halogen, Low Det. L	PPB	3-8-1	4/12/90	< 4.00	7.42	15.00	1.80	9	2
Total Organic Halogen, Low Det. L	PPB	3-8-2	6/13/89	11.00	9.09	15.00	2.60	7	1
Total carbon	PPB	3-8-1	6/05/89	28800.00	28150.00	28800.00	27500.00	2	2
Total carbon	PPB	3-8-2	6/13/89	31400.00	31150.00	31400.00	30900.00	2	2
Total dissolved solids		3-8-1	4/12/90	203000.00	221666.67	233000.00	203000.00	3	3
Total dissolved solids		3-8-2	6/13/89	243000.00	246000.00	249000.00	243000.00	2	2
Total organic carbon	PPB	3-8-1	4/12/90	< 600.00	426.70	600.00	300.00	10	0
Total organic carbon	PPB	3-8-2	6/13/89	< 600.00	666.26	1300.00	125.00	31	3
Total organic halogen	PPB	3-8-1	11/19/87	< 8.00	8.00	8.00	8.00	1	0
Total organic halogen	PPB	3-8-2	11/13/87	< 14.80	81.14	580.00	2.70	24	3
Toxaphene	PPB	3-8-1	4/12/90	< 1.00	1.00	1.00	1.00	7	0
Toxaphene	PPB	3-8-2	6/13/89	< 1.00	1.00	1.00	1.00	21	0
Trans-1,2-dichloroethene	PPB	3-8-1	5/23/90	< 5.00	6.00	10.00	5.00	5	0
Trans-1,2-dichloroethene	PPB	3-8-2	6/13/89	< 5.00	7.50	10.00	5.00	2	0
Tributylphosphoric Acid	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Tributylphosphoric Acid	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Trichloroethylene	PPB	3-8-1	5/23/90	< 5.00	4.00	5.00	3.00	8	0
Trichloroethylene	PPB	3-8-2	6/13/89	< 5.00	9.14	10.00	5.00	29	0
Trichloromethanethiol	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Trichloromethanethiol	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Trichloromonofluoromethane	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Trichloromonofluoromethane	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Trichloropropane	PPB	3-8-1	5/10/88	< 10.00	10.00	10.00	10.00	1	0
Trichloropropane	PPB	3-8-2	5/10/88	< 10.00	10.00	10.00	10.00	1	0
Tris(2,3-dibromopropyl) phosphate	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0

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SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Tris(2,3-dibromopropyl) phosphate	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Tritium	PCI/L	3-6-1	11/29/88	< -91.60	109.90	1920.00	-385.00	21	1
Tritium	PCI/L	3-8-1	4/12/90	< 156.00	71.62	230.00	-360.00	16	0
Tritium	PCI/L	3-8-2	12/02/88	< -45.20	-17.72	210.00	-390.00	13	0
Tritium	PCI/L	3-8-4	12/12/88	< 79.80	44.69	450.00	-241.00	12	0
Turbidity	NTU	3-8-1	4/12/90	.30	.20	.30	.10	2	1
Turbidity	NTU	3-8-2	6/13/89	.10	.10	.10	.10	1	1
Uranium	PCI/L	3-6-1	11/29/88	5.74	7.33	13.00	4.30	45	44
Uranium	PCI/L	3-8-1	4/12/90	3.41	6.06	22.00	2.60	41	41
Uranium	PCI/L	3-8-2	6/13/89	2.32	5.19	21.00	1.38	38	37
Uranium	PCI/L	3-8-4	12/12/88	1.70	5.47	15.00	.70	49	48
Uranium, chemical	UG/L	3-8-1	11/19/87	5.11	5.11	5.11	5.11	1	1
Uranium, chemical	UG/L	3-8-2	11/13/87	2.75	2.75	2.75	2.75	1	1
Vanadium	PPB	3-8-1	4/12/90	10.00	8.43	11.00	5.00	7	6
Vanadium	PPB	3-8-2	6/13/89	< 5.00	10.79	23.00	5.00	29	26
Vanadium, filtered	PPB	3-8-1	4/12/90	8.00	10.71	14.00	8.00	7	7
Vanadium, filtered	PPB	3-8-2	6/13/89	10.00	11.27	17.00	9.00	15	15
Vinyl Acetate	PPB	3-8-1	4/12/90	< 5.00	5.00	5.00	5.00	2	0
Vinyl Acetate	PPB	3-8-2	6/13/89	< 5.00	5.00	5.00	5.00	1	0
Vinyl chloride	PPB	3-8-1	5/23/90	< 10.00	10.00	10.00	10.00	5	0
Vinyl chloride	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Warfarin	PPB	3-8-1	4/12/90	< 10.00	10.00	10.00	10.00	3	0
Warfarin	PPB	3-8-2	6/13/89	< 10.00	10.00	10.00	10.00	2	0
Xylene-m	PPB	3-8-1	5/23/90	< 5.00	5.00	5.00	5.00	8	0
Xylene-m	PPB	3-8-2	6/13/89	< 5.00	9.14	10.00	5.00	29	0
Xylene-o,p	PPB	3-8-1	5/23/90	< 5.00	5.00	5.00	5.00	8	0
Xylene-o,p	PPB	3-8-2	6/13/89	< 5.00	9.14	10.00	5.00	29	0

Groundwater Results from Four Wells near the 618-9 Burial Ground

SAMPLE			LAST ANALYSIS		CONSTITUENT SUMMARY			NUMBER OF RESULTS	
Constituent	Units	Monitoring Well	Most Recent Sampling	Most Recent Result	Average Result	Maximum Result	Minimum Result	Total	Above Detection
Zinc	PPB	3-8-1	4/12/90	6.00	5.14	6.00	5.00	7	1
Zinc	PPB	3-8-2	6/13/89 <	5.00	5.06	6.00	5.00	16	3
Zinc, filtered	PPB	3-8-1	4/12/90 <	5.00	5.00	5.00	5.00	7	0
Zinc, filtered	PPB	3-8-2	6/13/89 <	5.00	5.27	9.00	5.00	15	2
Zirconium	PPB	3-8-1	4/12/90 <	50.00	50.00	50.00	50.00	3	0
Zirconium	PPB	3-8-2	6/13/89 <	50.00	50.00	50.00	50.00	1	0
Zirconium, filtered	PPB	3-8-1	4/12/90 <	50.00	50.00	50.00	50.00	3	0
Zirconium, filtered	PPB	3-8-2	6/13/89 <	50.00	50.00	50.00	50.00	1	0
dibromochloromethane	PPB	3-8-1	4/12/90 <	5.00	5.00	5.00	5.00	2	0
dibromochloromethane	PPB	3-8-2	6/13/89 <	5.00	5.00	5.00	5.00	1	0
m-Nitroaniline	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	2	0
m-Nitroaniline	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	1	0
o-Nitroaniline	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	2	0
o-Nitroaniline	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	1	0
o-Nitrophenol	PPB	3-8-1	4/12/90 <	10.00	10.00	10.00	10.00	2	0
o-Nitrophenol	PPB	3-8-2	6/13/89 <	10.00	10.00	10.00	10.00	1	0
p-Dichlorobenzene	PPB	3-8-1	5/23/90 <	5.00	7.14	10.00	5.00	7	0
p-Dichlorobenzene	PPB	3-8-2	6/13/89 <	5.00	9.67	10.00	5.00	15	0
p-Nitrophenol	PPB	3-8-1	4/12/90 <	10.00	23.33	50.00	10.00	3	0
p-Nitrophenol	PPB	3-8-2	6/13/89 <	10.00	30.00	50.00	10.00	2	0
pH, Field Measurement		3-6-1	12/29/77	7.90	7.84	7.90	7.70	7	7
pH, Field Measurement		3-8-1	5/23/90	7.87	7.77	8.00	7.11	18	18
pH, Field Measurement		3-8-2	6/13/89	7.30	7.56	8.10	6.90	38	38
pH, Laboratory Measurement		3-8-1	4/12/90	7.70	7.70	7.70	7.70	1	1

APPENDIX D

AIR MONITORING RESULTS

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Table D-1 Summary of Personal Air Monitoring

Date	Job Title	Exposure Duration (min)	Carbon Tetrachloride (ppm)	Hexone (ppm)	Kerosene (ppm)	Toluene (ppm)
4-2-91	D&D Worker	271	<0.06	<0.3	<3.7	0.08
	Pipefitter	268	<0.04	<0.01	<2.8	0.22
	Site Safety Officer	269	<0.04	0.06	<3.6	0.22
4-18-91	Crane Operator	217	NS**	NS**	NS**	NS**
	Iron Worker	225	<0.3	<0.005	4.6	0.027
	Driver	205	<0.04	<0.009	3.1	0.081

**NS = no sample due to equipment malfunction

Table D-2. Environmental Sampling Results. (sheet 1 of 2)

		ANALYTES		
Date	Sample Location	CCl_4 (ppm)	Hexone (ppm)	Kerosene (mg/m^3)
3/5/91	North Fence	<0.08	<0.01	<5
	South Fence	<0.08	<0.01	<5
	East Fence	<0.08	<0.01	<5
	West Fence	<0.08	<0.01	<5
	Down Wind	<0.08	<0.01	<5
3/6/91	North Fence	<0.07	<0.01	<4
	South Fence	<0.07	<0.01	<4
	East Fence	<0.07	<0.01	<4
	West Fence	<0.07	<0.01	<4
	Down Wind	<0.07	<0.01	<4
3/12/91	North Fence	<0.05	<0.008	<3
	South Fence	<0.05	<0.008	<3
	East Fence	<0.05	<0.009	<3
	West Fence	<0.05	<0.008	<3
	Down Wind	<0.05	<0.008	<3
3/19/91	North Fence	<0.07	<0/01	<4
	South Fence	<0.07	<0.01	<4
	East Fence	<0.06	<0.01	<4
	West Fence	<0.08	<0.01	<4
	Down Wind	<0.07	<0.01	<4
3/25/91	North Fence	<0.07	<0.01	<4
	South Fence	<0.07	0.22	<5
	East Fence	<0.07	<0.01	<5
	West Fence	<0.08	<0.01	<5
	Down Wind	<0.07	<0.01	<4

Table D-2. Environmental Sampling Results. (sheet 2 of 2)

		ANALYTES		
Date	Sample Location	CCl_4 (ppm)	Hexone (ppm)	Kerosene (mg/m^3)
4/12/91	North Fence	<0.08	<0.01	<5
	South Fence	<0.08	<0.01	<5
	East Fence	<0.08	<0.01	<5
	West Fence	<0.07	<0.01	<5
	Down Wind	<0.08	<0.01	<5
4/23/91	North Fence	NS	NS	NS
	South Fence	<0.05	<0.009	<3
	East Fence	<0.05	<0.009	<3
	West Fence	<0.05	<0.009	<3
	Down Wind	<0.05	<0.009	<3

NS = No sample due to equipment malfunction

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APPENDIX E

ANALYSIS RESULTS

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E-1 ANALYTICAL RESULTS

Included within this appendix are all the data sets received for the soil and liquid sampling at the 618-9 Burial Ground (Tables E-1 through E-5) (see Figure E-1). Data Sets Included Are:

1) Soil Sampling Results
2) Tentatively Identified Compound Evaluation

J = Estimated value
U = Undectected
B = Detected at the levels reported, also detected in the laboratory blank.

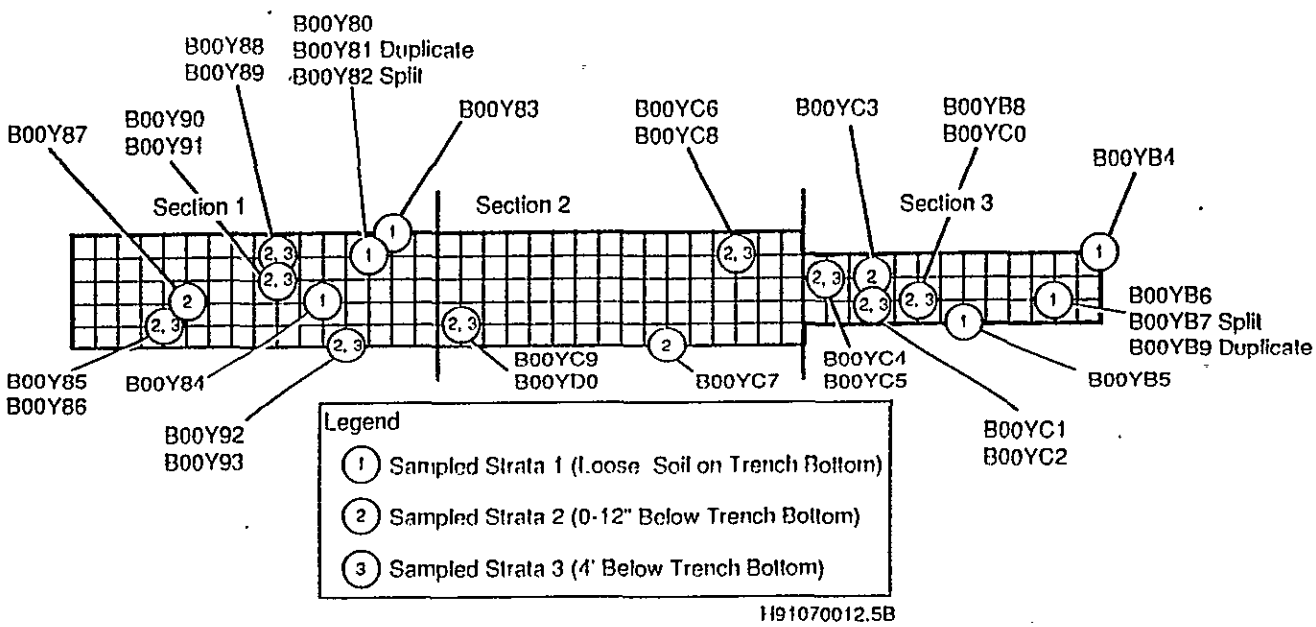

Table E-1. Volatile Organics Present in Soil Samples.

SECTION	STRATA	SAMPLE ID#	METHYLENE CHLORIDE	ACETONE	CHLORO-FORM	1,1,2,2,-TETRA CHLOROETHANE	TETRACHLORO-ETHENE	TOLUENE	TRICHLORO-ETHENE
1	1	B00Y84	39 BU	25 BU	5 U	5 U	5 U	5 U	5 U
1	1	B00Y80/Y81	62 B	30 BU	5 U	5 U	5 U	5 U	5 U
SPLIT	Y80/Y81	B00Y82	50	34	5 U	5 U	5 U	5 U	5 U
1	1	B00Y83	43 BU	19 BU	6 U	6 U	6 U	6 U	6 U
1	1	B00Y81/Y80	38 BU	29 BU	5 U	5 U	5 U	5 U	5 U
1	2	B00Y90	21 BU	26 BU	5 U	5 U	5 U	5 U	5 U
1	2	B00Y85	40 BU	42 BU	5 U	5 U	5 U	5 U	5 U
1	2	B00Y92	28 BU	40 BU	6 U	6 U	6 U	6 U	6 U
1	2	B00Y87	28 BU	35 BU	5 U	5 U	5 U	5 U	5 U
1	2	B00Y88	27 B	27 BU	5 U	5 U	5 U	1 J	5 U
1	3	B00Y89	20 BU	24 BU	5 U	5 U	5 U	5 U	5 U
1	3	B00Y86	46 BU	33 BU	6 U	6 U	6 U	6 U	6 U
1	3	B00Y91	24 B	17 BU	5 U	5 U	5 U	5 U	5 U
1	3	B00Y93	1100 U	1300 U	650 U	650 U	650 U	650 U	650 U
2	2	B00YC7	240 B	180 BU	9 J	110	100	26 U	26 U
2	2	B00YC6/YC9	190 B	190 BU	24 U	86	78	24 U	24 U
2	2	B00YC9/YC6	31 BU	29 BU	6 U	6 U	6 U	6 U	6 U
2	3	B00YD0	42 BU	35 BU	6 U	6 U	6 U	6 U	6 U
2	3	B00YC8	140 B	140 BU	6 J	26 U	46	26 U	26 U
3	1	B00YB6/YB9	51 BU	18 BU	5 U	5 U	5 U	5 U	5 U
SPLIT	YB6/YB9	B00YB7	17	64	5 U	5 U	5 U	9	5 U
3	1	B00YB9/YB6	38 BU	20 BU	5 U	5 U	5 U	5 U	5 U
3	1	B00YB4	34 BU	27 U	6 U	6 U	6 U	6 U	6 U
3	1	B00YB5	26 BU	25 U	5 U	5 U	5 U	5 U	5 U
3	2	B00YC3	35 BU	48 BU	5 U	5 U	5 U	5 U	5
3	2	B00YB8	19 BU	23 BU	5 U	1 J	4 J	5 U	2 J
3	2	B00YC1	130 B	280 B	26 U	31	24 J	26 U	26 U
3	2	B00YC4	140 B	190 B	26 U	41	100	26 U	26 U
3	3	B00YC2	2300 B	680 JB	650 U	650 U	320 J	650 U	650 U
3	3	B00YC5	1800 BU	1300 U	660 U	660 U	920	660 U	660 U
3	3	B00YC0	26 BU	42 BU	5 U	8	27	2 J	5 U
BLANK	FIELD	B00Y95	28 BU	53 BU	5 U	5 U	5 U	2 J	5 U
BLANK	FIELD	B00YB2	48 BU	55 BU	5 U	5 U	5 U	5 U	5 U
BLANK	TRIP	B00YB1	42 BU	41 BU	5 U	5 U	5 U	5 U	5 U
BLANK	TRIP	B00Y94	40 BU	64 BU	5 U	5 U	5 U	1 J	5 U
SPOIL	PILE	B00Y97	35 BU	24 U	5 U	5 U	5 U	5 U	5 U
SPOIL	PILE	B00Y99	27 BU	21 U	6 U	6 U	6 U	6 U	6 U
SPOIL	PILE	B00YB3	29 BU	23 U	6 U	6 U	6 U	6 U	6 U
SPOIL	PILE	B00Y98	26 BU	17 U	5 U	5 U	5 U	5 U	5 U

Table E-2. Semivolatile Organics Present in Soil Samples.

SECTION	STRAT	SAMPLE ID #	HEXACHLORO-ETHANE	HEXACHLORO-BUTADIENE	PHENAN-THRENE	DI-N-BUTYL PHTHALATE	BUTYLBENZYL PHTHALATE	BIS(2-ETHYL-HEXYL)PHTHALATE
1	1	B00Y84	350 UJ	350 UJ	350 UJ	590 J	350 UJ	350 UJ
1	1	B00Y80/Y81	340 UJ	340 UJ	340 UJ	95 J	340 UJ	43 J
SPLIT	Y80/Y81	B00Y82	31 U	31 U	31 U	1400 BU	31 U	36 BU
1	1	B00Y83	340 UJ	340 UJ	340 UJ	230 J	340 UJ	340 UJ
1	1	B00Y81/Y80	340 UJ	340 UJ	340 UJ	300 J	340 UJ	47 J
1	2	B00Y90	350 UJ	350 UJ	350 UJ	180 J	350 UJ	350 UJ
1	2	B00Y85	360 UJ	360 UJ	360 UJ	200 J	360 UJ	360 UJ
1	2	B00Y92	350 UJ	350 UJ	350 UJ	350 J	350 UJ	58 J
1	2	B00Y87	350 UJ	350 UJ	350 UJ	110 J	350 UJ	37 J
1	2	B00Y88	350 U	350 U	350 U	2700 BU	350 U	350 U
1	3	B00Y89	330 U	330 U	330 U	1100 BU	330 U	330 U
1	3	B00Y86	340 UJ	340 UJ	340 UJ	51 J	340 UJ	340 UJ
1	3	B00Y91	330 U	330 U	330 U	1200 BU	330 U	330 U
1	3	B00Y93	340 U	340 U	340 U	1000 BU	340 U	340 U
2	2	B00YC7	1700 U	440 J	240 J	2100	1700 U	1700 U
2	2	B00YC6	500	300 J	340 U	5500	340 U	340 U
2	2	B00YC9	340 U	340 U	340 U	3100	38 J	340 U
2	3	B00YD0	350 U	350 U	350 U	3800	81 J	350 U
2	3	B00YC8	710	390	340 U	6200 J	150 J	340 U
3	1	B00YB6/YB9	340 U	300 J	340 U	5500	340 U	340 U
SPLIT	B6/YB	B00YB7	30 U	150	30 U	1100 BU	30 U	54 BU
3	1	B00YB9/YB6	330 U	330 U	330 U	3600	330 U	330 U
3	1	B00YB4	340 U	340 U	340 U	2400	340 U	340 U
3	1	B00YB5	340 U	340 U	340 U	2000	340 U	340 U
3	2	B00YC3	340 U	340 U	340 U	3200	340 U	340 U
3	2	B00YB8	1700 U	1700 U	1700 U	3300	810 J	1700 U
3	2	B00YC1	110 J	120 J	340 U	4200	850	340 U
3	2	B00YC4	720	270 J	350 U	3800	2700	350 U
3	3	B00YC2	3300	760	350 U	5300	530	350 U
3	3	B00YC5	17000	3500 U	3500 U	1700 J	1100 J	3500 U
3	3	B00YC0	3400 U	3400 U	3400 U	1700 J	2600 J	5200
SPOIL	PILE	B00Y97	340 U	340 U	340 U	1700	340 U	340 U
SPOIL	PILE	B00Y99	340 U	340 U	340 U	2500	340 U	340 U
SPOIL	PILE	B00YB3	350 U	350 U	350 U	2800	350 U	350 U
SPOIL	PILE	B00Y98	340 U	340 U	340 U	1500	340 U	340 U

Table E-3. Metals Present in Soil Samples. (sheet 1 of 3)

SECTION	STRATA	SAMPLE ID#	AL	AR	SB	BA	BE	CA	CD	CO
1	1	B00Y84	3169.50 J	2.00 U	3.50 U	56.60	0.29 B	2469.20 J	0.73 U	5.40 B
1	1	B00Y80/Y81	2501.00 J	1.60 U	3.81 U	47.90	0.26 B	2572.30 J	0.80 U	4.70 B
SPLIT	Y80/Y81	B00Y82	6140.00	NR	3.40 U	64.40	0.23 B	3410.00	0.59 U	9.30 B
1	1	B00Y83	3029.60 J	1.90 U	3.63 U	52.90	0.23 B	3536.60 J	0.77 U	5.00 B
1	1	B00Y81/Y80	3037.10 J	2.00 U	3.40 U	58.20	0.29 B	3161.60 J	0.71 U	5.40 B
1	2	B00Y90	2105.30 J	1.80 U	3.87 U	34.80 B	0.20 U	3053.30 J	0.81 U	4.40 B
1	2	B00Y85	2739.70 J	1.90 U	3.07 U	49.40	0.21 B	2630.40 J	0.66 U	4.70 B
1	2	B00Y92	2718.40 J	1.90 U	4.00 U	43.90	0.25 B	3558.70 J	0.84 U	5.00 B
1	2	B00Y87	2592.30 J	1.70 U	3.10 U	46.80	0.26 B	3821.80	0.65 U	5.80 B
1	2	B00Y88	4480.00	1.90 U	2.92 U	88.10	0.45 B	5710.00	0.62 U	12.30
1	3	B00Y89	2240.00	1.70 U	2.72 U	43.80	0.24 B	3860.00	0.57 U	7.20
1	3	B00Y86	2400.60 J	1.70 U	3.47 U	52.90	0.22 B	4564.00 J	0.73 U	6.20 B
1	3	B00Y91	2130.00	2.00 U	2.69 U	43.10	0.23 B	4170.00	0.57 U	6.60 B
1	3	B00Y93	3110.00	2.10 U	2.83 U	58.10	0.30 B	4720.00	0.60 U	9.80
2	2	B00YC7	3414.60	1.90 U	3.55 U	60.80	0.24 B	3120.40	0.75 U	6.50 B
2	2	B00YC6	1783.20	1.80 U	2.66 U	35.60	0.14	3895.40	0.56 U	5.40 B
2	2	B00YC9	3340.80	1.90 U	3.12 U	65.80	0.25 B	3700.80	0.66 U	6.50 B
2	3	B00YD0	1671.00	2.00 U	3.06 U	52.20	0.16 U	3590.90	0.64 U	4.80 B
2	3	B00YC8	1646.20	1.80 U	3.25 U	32.70 B	0.17 U	3207.10	0.68 U	4.50 B
3	1	B00YB6/YB9	4265.50	1.90 U	3.46 U	78.20	0.33 B	3333.30	0.73 U	7.30 B
SPLIT	YB6/YB9	B00YB7	8570.00	NR	3.20 U	90.20	0.33 B	4170.00	0.57 U	11.40
3	1	B00YB9/YB6	4470.50	2.00 U	3.12 U	72.80	0.31 B	3281.50	0.66 U	7.40 B
3	1	B00YB4	3194.40	11.60	3.65 U	56.00	0.25 B	3084.10	0.77 U	5.70 B
3	1	B00YB5	3700.20	1.80 U	3.25 U	64.30	0.31 B	3326.10	0.68 U	6.80 B
3	2	B00YC3	1678.10	2.00 U	3.50 U	29.60 B	0.18 U	2641.10	0.74 U	4.10 B
3	2	B00YB8	3000.00 J	2.00 U	3.80 U	59.30 J	0.20 B	3310.00 J	0.79 U	6.40 B
3	2	B00YC1	1400.00 J	1.90 U	3.32 U	21.90 BJ	0.18 U	2680.00 J	0.70 U	3.60 B
3	2	B00YC4	1900.00 J	1.70 U	3.03 U	28.80 BJ	0.16 U	2970.00 J	0.64 U	4.60 B
3	3	B00YC2	1460.00 J	1.90 U	3.91 U	21.00 BJ	0.21 U	2260.00 J	0.82 U	3.60 B
3	3	B00YC5	2050.00 J	1.70 U	3.32 U	39.30 J	0.18 U	3430.00 J	0.70 U	5.70 B
3	3	B00YC0	3300.00 J	1.60 U	3.65 U	62.60 J	0.19 U	3560.00 J	0.77 U	7.20 B
BLANK	EQUIP	B00YBO	151.40	1.90 U	3.16 U	3.90 B	0.17 U	133.30 B	0.66 U	0.66 U
BLANK	EQUIP	B00Y96	181.40 J	1.70 U	3.63 U	24.40 B	0.19 U	130.20 BJ	0.76 U	0.76 U
SPOIL	PILE	B00Y97	3373.60	1.80 U	2.97 U	69.00	0.28 B	2786.10	0.63 U	7.00 B
SPOIL	PILE	B00Y99	3340.50	2.10 U	3.37 U	56.50	0.23 B	3294.30	0.71 U	5.80 B
SPOIL	PILE	B00YB3	3161.10	1.90 U	3.39 U	57.20	0.23 B	2599.10	0.71 U	5.50 B
SPOIL	PILE	B00Y98	3323.80	1.70 U	3.81 U	55.80	0.26 B	3585.50	0.80 U	6.00 B

Table E-3. Metals Present in Soil Samples. (sheet 2 of 3)

SECTION	STRATA	SAMPLE ID#	CR	CU	CYANIDE	FE	HG	MG	MN	NI
1	1	B00Y84	0.55 U	5.10	514.60 U	10181.10 J	0.10 U	2242.60 J	229.50 J	5.10 B
1	1	B00Y80/Y81	0.60 U	5.70	53.11 U	7674.90 J	0.10 U	1769.40 J	180.70 J	4.70 B
SPLIT	Y80/Y81	B00Y82	6.70	11.20	NR	19100.00	NR	3690.00	309.00	8.30
1	1	B00Y83	0.57 U	6.70	50.85 U	9440.60 J	0.10 U	2331.90 J	204.50 J	6.00 B
1	1	B00Y81/Y80	0.54 U	6.40	53.43 U	9643.40 J	0.10 U	2298.80 J	226.10 J	6.10 B
1	2	B00Y90	0.61 U	8.10	54.09 U	7920.20 J	0.11 U	1898.30 J	118.30 J	3.70 B
1	2	B00Y85	0.49 U	5.50	53.90 U	8724.90 J	0.11 U	2009.60 J	199.40 J	5.20 B
1	2	B00Y92	0.63 U	8.70	84.45 U	9248.10 J	0.10 U	2328.80 J	145.50 J	4.50 B
1	2	B00Y87	0.49 U	9.40	53.23 U	10371.70 J	0.10 U	2377.60 J	159.10 J	5.10 B
1	2	B00Y88	0.46 U	14.10	NR	20400.00	0.11 U	4210.00	313.00 J	9.10
1	3	B00Y89	0.43 U	9.50	NR	12000.00	0.10 U	2280.00	170.00 J	4.20 B
1	3	B00Y86	0.55 U	10.00	52.59 U	11589.00 J	0.10 U	2681.30 J	160.80 J	4.40 B
1	3	B00Y91	0.42 U	10.20	NR	11600.00	0.10 U	2210.00	153.00 J	3.70 B
1	3	B00Y93	0.45 U	12.30	NR	16800.00	0.10 U	3390.00	231.00 J	6.90
2	2	B00YC7	0.56 U	10.50 U	NR	14207.90	0.10 U	2396.00	213.90 J	7.50
2	2	B00YC6	0.42 U	9.30 U	NR	9350.40	0.10 U	1835.00	124.70 J	3.90 B
2	2	B00YC9	0.49 U	9.90 U	NR	11766.80	0.19	2547.00	232.30 J	7.90
2	3	B00YD0	0.48 U	8.30 U	NR	8228.40	0.10 U	1536.60	105.30 J	2.70 B
2	3	B00YC8	0.51 U	8.30 U	NR	8069.30	0.15	1556.90	103.20 J	3.40 B
3	1	B00YB6/YB9	0.55 U	8.40 U	NR	13469.60	0.10 U	2903.40	279.80 J	7.90
SPLIT	YB6/YB9	B00YB7	9.70	16.70	NR	24900.00	NR	4450.00	359.00	10.60
3	1	B00YB9/YB6	0.49 U	8.90 U	NR	13358.60	0.10 U	3007.50	279.60 J	7.60
3	1	B00YB4	0.58 U	7.60 U	NR	10617.20	0.10 U	2233.00	200.40 J	5.50 B
3	1	B00YB5	0.51 U	8.00 U	NR	12369.00	0.10 U	2738.20	250.30 J	8.40
3	2	B00YC3	0.55 U	8.10 U	NR	9932.60	0.10 U	1557.30	106.90 J	3.40 B
3	2	B00YB8	0.59 U	8.90	NR	11800.00 J	0.22	2110.00 J	229.00 J	6.10 BU
3	2	B00YC1	0.53 U	6.10	NR	11500.00 J	0.23	1190.00 J	82.10 J	2.30 BU
3	2	B00YC4	0.48 U	7.80	NR	9490.00 J	0.33	1590.00 J	111.00 J	3.80 BU
3	3	B00YC2	0.62 U	6.10	NR	9360.00 J	0.22	1150.00 J	81.80 J	3.00 BU
3	3	B00YC5	0.52 U	8.30	NR	8810.00 J	0.51	1720.00 J	152.00 J	4.10 BU
3	3	B00YC0	0.58 U	13.00	NR	13200.00 J	0.28	2330.00 J	251.00 J	8.90 U
BLANK	EQUIP	B00YBO	0.50 U	1.16 U	NR	755.10	0.10 U	57.40 B	26.80 J	1.16 U
BLANK	EQUIP	B00Y96	0.57 U	1.40 B	NR	671.20 J	0.10 U	47.00 UJ	82.70 UJ	1.34 U
SPOIL	PILE	B00Y97	0.47 B	7.40 U	NR	10464.70	0.10 U	2395.70	298.40 J	6.80
SPOIL	PILE	B00Y99	0.53 U	7.80 U	NR	10395.90	0.10 U	2300.20	221.20 J	6.30 B
SPOIL	PILE	B00YB3	0.53 U	6.00 U	NR	9417.90	0.10 U	2110.40	222.10 J	5.80 B
SPOIL	PILE	B00Y98	0.60 U	7.20 U	NR	10494.20	0.10 U	2450.40	223.00 J	6.70 B

Table E-3. Metals Present in Soil Samples. (sheet 3 of 3)

SECTION	STRATA	SAMPLE ID#	K	AG	NA	PB	SE	TL	V	ZN
1	1	B00Y84	1059.90 U	0.73 U	127.10 UJ	3.10	0.99 U	2.00 U	16.80 U	25.00
1	1	B00Y80/Y81	733.10 U	0.80 U	104.90 UJ	3.20	0.81 U	1.60 U	13.10 U	21.30
SPLIT	Y80/Y81	B00Y82	1180.00	0.99 U	151.00 B	NR	NR	NR	49.90	39.00
1	1	B00Y83	740.60 BU	0.84 BU	121.90 UJ	3.40	0.96 U	1.90 U	12.80 U	23.30
1	1	B00Y81/Y80	860.30 BU	0.71 U	124.10 UJ	1.50	1.00 U	2.00 U	15.40 U	20.80
1	2	B00Y90	447.10 BU	0.81 U	146.70 UJ	2.00	0.89 U	1.80 U	9.50 BU	13.70
1	2	B00Y85	853.90 U	0.65 U	99.40 UJ	3.00	0.94 U	1.90 U	13.20 U	22.20
1	2	B00Y92	458.70 BU	0.84 U	177.00 UJ	3.00	0.96 U	1.90 U	11.70 U	17.30
1	2	B00Y87	531.30 BU	0.65 U	129.50 J	1.50	0.85 U	1.70 U	12.30 U	17.80
1	2	B00Y88	804.00	0.62 U	201.00 BU	3.00	0.93 U	1.90 U	29.80	33.90
1	3	B00Y89	357.00 B	0.57 U	118.00 U	1.30	0.85 U	1.70 U	12.90	19.40
1	3	B00Y86	503.60 BU	0.73 U	182.90 UJ	1.50	0.86 U	1.70 U	13.20 U	18.60
1	3	B00Y91	312.00 B	0.57 U	131.00 BU	1.50	1.00 U	2.00 U	11.20	19.00
1	3	B00Y93	400.00 B	0.60 U	149.00 BU	2.00	1.00 U	2.10 U	24.40	27.50
2	2	B00YC7	1010.80	1.30 B	108.60 BU	4.10	0.94 U	1.90 U	14.10 U	66.90
2	2	B00YC6	319.30 B	1.00 B	102.70 BU	1.20	0.90 U	1.80 U	7.70 U	14.30
2	2	B00YC9	842.20	1.30 B	97.10 BU	7.70	0.94 U	1.90 U	16.10 U	36.10
2	3	B00YD0	241.70 B	0.64 U	82.40 BU	1.30	0.98 U	2.00 U	9.80 U	15.30
2	3	B00YC8	352.20 B	0.68 U	102.80 BU	0.97	0.90 U	1.80 U	7.40 BU	14.00
3	1	B00YB6/YB9	1411.90	1.40 B	102.50 BU	4.50	0.97 U	1.90 U	17.70 U	30.80
SPLIT	YB6/YB9	B00YB7	1800.00	0.95 U	168.00 B	NR	NR	NR	59.30	52.30
3	1	B00YB9/YB6	1253.70	1.40 B	114.40 BU	1.80	1.00 U	2.00 U	19.10 U	27.70
3	1	B00YB4	906.30 B	1.00 B	111.30 BU	3.50	0.94 U	1.90 U	13.90 U	22.70
3	1	B00YB5	1029.50	1.00 B	101.40 BU	3.60	0.90 U	1.80 U	16.30 U	34.80
3	2	B00YC3	529.50 B	0.81 B	102.70 BU	1.20	1.00 U	2.00 U	6.90 BU	13.80
3	2	B00YB8	703.00 B	3.10 U	71.30 B	4.50	0.99 U	2.00 U	9.90 B	42.80
3	2	B00YC1	176.00 U	2.50 U	67.40 B	1.30	0.94 U	1.90 U	1.90 B	12.60
3	2	B00YC4	300.00 B	2.20 U	79.30 B	1.70	0.83 U	1.70 U	5.70 B	13.70
3	3	B00YC2	226.00 B	2.30 U	72.20 B	1.80	0.95 U	1.90 U	2.80 B	10.70
3	3	B00YC5	282.00 B	1.50 BU	83.10 B	4.20	0.86 U	1.70 U	7.50 B	19.50
3	3	B00YC0	867.00 B	2.50 U	80.90 B	4.30	0.82 U	1.60 U	11.00	63.10
BLANK	EQUIP	B00YBO	167.36 U	0.66 U	26.50 BU	0.78	0.95 U	1.90 U	1.50 BU	3.00 B
BLANK	EQUIP	B00Y96	226.30 BU	0.76 U	23.60 UJ	0.81	0.86 U	1.70 U	1.53 U	2.60 B
SPOIL	PILE	B00Y97	961.60	1.10 B	79.30 BU	3.70	0.92 U	1.80 U	16.30 U	22.30
SPOIL	PILE	B00Y99	925.40	0.99 B	85.60 BU	3.50	1.00 U	2.10 U	14.80 U	37.40
SPOIL	PILE	B00YB3	975.80	1.20 B	77.90 BU	3.60	0.93 U	1.90 U	14.40 U	21.30
SPOIL	PILE	B00Y98	793.30 B	0.92 B	98.40 BU	3.00	0.83 U	1.70 U	15.00 U	20.80

Table E-4. Inorganics Present in Soil Samples.

SECTION	STRATA	SAMPLE ID	% SOLIDS	CHLORIDE	NITRATE	NITRITE	FLOURIDE	PHOSPHATE	SULFATE
1	1	B00Y84	95.6	27.3	106.0	1.3 U	2.6 U	2.0	3.6 J
1	1	B00Y80/Y81	96.1	53.9	1.3 U	1.3 U	2.7 U	1.3 U	1.3 UJ
1	1	B00Y83	96.7	42.0	41.2	1.3 U	2.5 U	1.3 U	6.8 J
1	1	B00Y81/Y80	95.7	46.5	1.3 U	1.3 U	2.7 U	1.3 U	1.3 UJ
1	2	B00Y90	95.4	30.9	1.9	1.4 U	2.7 U	1.4 U	1.4 UJ
1	2	B00Y85	97.3	19.5	45.0	1.3 U	2.7 U	2.4	4.5 J
1	2	B00Y92	94.1	19.3	84.4	1.3 U	2.6 U	1.3 U	10.0 J
1	2	B00Y87	96.9	31.1	9.0	1.3 U	2.7 U	1.3 U	1.3 UJ
1	2	B00Y88	98.7	24.9	89.4 J	1.4 U	2.7 U	1.4 U	5.2 J
1	3	B00Y89	97.2	16.6	8.9 J	1.4 U	2.8 U	1.4 U	1.4 UJ
1	3	B00Y86	94.6	14.8	18.7	1.3 U	2.6 U	1.3 U	1.3 UJ
1	3	B00Y91	96.7	17.3	6.8 J	1.3 U	2.5 U	1.3 U	1.3 UJ
1	3	B00Y93	96.7	24.8	1.3 UJ	1.3 U	2.6 U	5.2	1.3 UJ
2	2	B00YC7	97.0	220.0	28.0	1.3 U	2.5 UJ	6.9 J	310.0
2	2	B00YC6	97.0	267.0	1.3 U	1.3 U	2.6 UJ	1.3 UJ	4.0
2	2	B00YC9	91.8	14.0	1670.0	1.3 U	2.6 UJ	2.0 J	983.0
2	3	B00YD0	94.6	3.9	1450.0	1.3 U	2.7 UJ	1.3 UJ	771.0
2	3	B00YC8	97.6	194.0	1.3 U	1.3 U	2.7 UJ	1.3 UJ	1.3 U
3	1	B00YB6/YB9	99.1	116.0	111.0	1.3 U	2.6 UJ	43.4 J	21.8
3	1	B00YB9/YB6	98.2	44.8	34.1	1.3 U	2.6 UJ	12.7 J	8.6
3	1	B00YB4	97.0	86.2	5.7	1.3 U	2.6 UJ	40.7 J	8.5
3	1	B00YB5	96.5	73.1	1.3 U	1.3 U	2.5 UJ	39.2 J	21.7
3	2	B00YC3	97.3	169.0	53.8	1.3 U	2.6 UJ	10.9 J	9.1
3	2	B00YB8	98.4	81.0	9.8 J	1.3 U	2.6 U	13.8	25.3 J
3	2	B00YC1	97.3	196.0	1.3 UJ	1.3 U	2.6 U	1.3 U	1.3 UJ
3	2	B00YC4	97.0	678.0	1.3 UJ	1.3 U	2.7 U	1.3 U	1.7 J
3	3	B00YC2	95.9	384.0	1.3 UJ	1.3 U	2.6 U	1.3 U	1.3 UJ
3	3	B00YC5	95.2	189.0	1.3 UJ	1.3 U	2.7 U	2.8	1.3 UJ
3	3	B00YC0	96.7	82.0	26.3 J	1.3 U	2.6 U	17.1	94.7 J
BLANK	EQUIP	B00YBO	99.9						
BLANK	EQUIP	B00Y96	99.8						
BLANK	FIELD	B00Y95	100.0						
BLANK	FIELD	B00YB2	100.0						
BLANK	TRIP	B00YB1	100.0						
BLANK	TRIP	B00Y94	100.0						
SPOIL	PILE	B00Y97	95.7	4.1	265.0	1.3 U	2.6 UJ	4.0 J	153.0
SPOIL	PILE	B00Y99	95.9	3.5	108.0	1.3 U	2.6 UJ	2.3 J	226.0
SPOIL	PILE	B00YB3	94.5	2.2	2.7	1.3 U	2.7 UJ	1.8 J	1.3 U
SPOIL	PILE	B00Y98	96.1	1.7	8.5	1.3 U	2.6 UJ	2.9 J	2.5

Table E-5. Pesticides Present in Split Samples.

SECTION	STRATA	SAMPLE ID #	ALDRIN	HEPTACHLOR EPOXIDE	ALPHA-CHLORDANE	GAMMA-CHLORDANE
SPLIT	B00YB6/YB9	B00YB7	390.0	44.0	81.0 U	69.0 JX
SPLIT	B00YB6/YB9	B00YB7DL5	740.0 D	42.0 D	400.0 U	53.0 DJX
SPLIT	B00YB6/YB9	B00YB7DL10	770.0 DX	40.0 DJX	810.0 U	52.0 DJX

E-2 TENTATIVELY IDENTIFIED COMPOUNDS

To: Jil Frain

From: Loren K. Thompson, Ph.D. LKT

Subject: TIC interpretation of Semivolatile GCMS CLP assay

Date: July 30, 1991

==========

After careful study of the GCMS analysis of your samples, I can conclude the following about your samples:

All VOA TICs found with retention times greater than 20 minutes can be associated with the presence of Kerosene in the sample. Since Kerosene is only partially eluted in the VOA assay, the quantitation of the material is more difficult than in the Semivolatile assay. Therefore, the VOA assay was used only in the confirmation of Kerosene as compared to the identification and quantitation of the Kerosene in the Semivolatile assays.

SEMIVOLATILE TIC INTERPRETATIONS

SAMPLE B00Y80 (Lab File ID: M070321)

TICs 1 and 2 are Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TIC 3 to 12: All are associated with the **Kerosene** GCMS pattern. My graphical integration estimates the total Kerosene at a concentration = 16 ppm.

SAMPLE B00Y81 (Lab File ID: M070324)

TICs 1, 2 and 3 are Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TIC 4: Alkane Hydrocarbon

TIC 5: Cyclohexanol

TIC 6: Unknown

TICs 7 and 8: All are associated with the **Kerosene** GCMS pattern. My graphical integration estimates the total Kerosene concentration = 6.3 ppm.

SAMPLE B00Y83 (Lab File ID: M070325)

TICs 1, 2 and 3 are Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

SAMPLE B00Y84 (Lab File ID: M062805)

TIC 1 is an unknown compound.

TICs 2, 3 and 4 are Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

SAMPLE B00Y85 (Lab File ID: L070105)

TICs 1 and 2 are Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TIC 3: Organic Acid (i.e. Fatty Acid)

SAMPLE B00Y86 (Lab File ID: L070106)

TICs 1 and 2 are Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TIC 3: Unknown

SAMPLE B00Y87 (Lab File ID: L070107)

TICs 1 and 2 are Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TICs 3, 4 and 5: Unknowns

SAMPLE B00Y88 (Lab File ID: L060306)

TIC 1: Unknown Hydrocarbon

SAMPLE B00Y90 (Lab File ID: M070326)

TICs 1, 2 and 3 are Aldol Condensates and are probably, reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TICs 4 to 9: Are Alkane which are not associated with Kerosene pattern due to their early elution time (i.e. short chained alkanes).

SAMPLE B00Y92 (Lab File ID: M070327)

TICs 1 to 5 are all Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

SAMPLE B00Y93 (Lab File ID: L060310)

TICs 1 to 5: Are Alkane which are not associated with Kerosene pattern due to their early elution time (i.e. short chained alkanes).

TICs 6 to 12: Are Alkanes which can be associated with the Kerosene GCMS pattern. My graphical integration is unable to quantitate the total Kerosene and I recommend adding all these peaks together which results in a total Kerosene concentration = 13.1 ppm.

TIC 13: Tributyl phosphate at 30 ppm.

SAMPLE B00Y97 (Lab File ID: J062810)

TICS 1, 2, 3 and 4 are all Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TICs 5 and 6: Unknown components

TICs 7 and 8: Alkane Hydrocarbons

SAMPLE B00Y98 (Lab File ID: J062811)

TICs 1,4, and 5: Unknown

TICS 2 and 3 are all Aldol Condensate and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

SAMPLE B00Y99 (Lab File ID: J062812)

TICs 1, 5 and 6: Unknown

TICS 2, 3 and 4 are all Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TIC 7: Alkane Hydrocarbon

SAMPLE B00YB3 (Lab File ID: J062813)

TICs 1, 4 and 5: Unknown

TICS 2 and 3 are all Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TIC 6: Alkane Hydrocarbon

SAMPLE B00YB5 (Lab File ID J062815)

TICS 1 and 2 are all Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TICs 3 - 9: All are associated with the **Kerosene** GCMS pattern. My graphical integration estimate of the total Kerosene concentration = 6.5 ppm.

Tic 10: Tributyl Phosphate at 600 ppb.

TICs 11-21: Appear to be associated with a high boiling point composite mixture composed mostly of alkane hydrocarbons. My graphical integration estimate of the total 'high boiling point hydrocarbon composite' = 38 ppm.

SAMPLE B00YB6 (Lab File ID: J070212)

TIC 1 is an Aldol Condensate and is probably a reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that this may be ignored.

TIC 2 ,3 ,4 retention times and GCMS pattern strongly suggest that Kerosene pattern would be revealed if the attentuation was amplified in the chromatogram. My graphical integration is unable to quantitate the total Kerosene and I recommend adding all these peaks together which results in a total Kerosene concentration = 1.5 ppm.

TIC 5: Trichlorobenzene at .2 ppm

TIC 7 Pentachlorobenzene at .3 ppm

TIC 9: Tributylphosphate at 100 ppm

TIC 6 and 11: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TICs 10, 12 to 20: All appear to be "unknown hydrocarbon mixture" and therefore the total concentration can be estimated by the addition of these peaks and found to be 11100 ppb.

SAMPLE B00YB8 (Lab File ID: L060614)

TICs 1 - 9: All are associated with the **Kerosene** GCMS pattern. My graphical integration is unable to quantitate the total Kerosene and I recommend adding all these peaks together which results in a total Kerosene concentration = 16 ppm.

TIC 10: Tributyl Phosphate = 100 ppm.

TIC 11 and 12: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TIC 13: Unknown.

SAMPLE B00YB9 (Lab File ID: J070213)

TICs 1, 7, 8, 9 and 10: Unknown

TICS 2 and 3 are all Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TIC 4: Tributyl Phosphate at 70 ppm

TICs 5 and 6: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TIC 11: Alkane Hydrocarbon

SAMPLE B00YC0 (Lab File ID: L061109) :

TICs 1 to 17 are all associated with the Kerosene GC/MS patterns. My graphical integration results in total Kerosene = 8.8 ppm

TIC 18: Tributyl Phosphate at 30 ppm

TICs 19, 20 and 21: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

SAMPLE B00YC1 (Lab File ID L060610)

TIC 1 to 16: All are associated with the Kerosene GCMS pattern. My graphical integration estimates the total Kerosene at a concentration = 210 ppm.

TIC 17: Tributyl phosphate at 200 ppm.

TIC 18 and 19: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TIC 20 and 21: unknown

TIC 22: Phthalate ester probably a laboratory or field sampling contaminant.

SAMPLE B00YC2 (Lab File ID: L060611)

TICs 1 - 13: All are associated with the Kerosene GCMS pattern. My graphical integration is unable to quantitate the total Kerosene and I recommend adding all these peaks together which results in a total Kerosene concentration = 650 ppm.

TIC 14: Tributyl Phosphate at 600 ppm

TICs 15, 16 and 17: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TIC 18 and 19: Unknown

SAMPLE B00YC3 (Lab File ID: J070214)

TICs 1 - 19: All are associated with the **Kerosene** GCMS pattern. My graphical integration is unable to quantitate the total Kerosene and I recommend adding all these peaks together which results in a total Kerosene concentration = 61 ppm.

TIC 20: Tributyl Phosphate at 5 ppm

TICs 21: Appears to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

SAMPLE B00YC4 (Lab File ID: L060612)

TICs 1 - 15: All are associated with the **Kerosene** GCMS pattern. My graphical integration is unable to quantitate the total Kerosene and I recommend adding all these peaks together which results in a total Kerosene concentration = 530 ppm.

TIC 16: Tributyl Phosphate at 30 ppm

TICs 17, 18 and 19: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TIC 20: Phthalate ester: a common laboratory or field sampling contaminant.

SAMPLE B00YC5 (Lab File ID: S060707)

TICs 1 - 16: All are associated with the **Kerosene** GCMS pattern. My graphical integration is unable to quantitate the total Kerosene and I recommend adding all these peaks together which results in a total Kerosene concentration = 190 ppm.

TIC 17: Tributyl Phosphate at 2000 ppm

TICs 18, 19 and 20: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

SAMPLE B00YC6 (Lab File ID: J070215)

TICs 1 - 16: All are associated with the **Kerosene** GCMS pattern. My graphical integration estimates the total Kerosene at a concentration = 210 ppm.

TIC 17: Tributyl Phosphate at 100 ppm.

TICs 18 and 19: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TICs 20 and 21: Unknown

SAMPLE B00YC7 (Lab File ID J070505)

TICs 1 - 5: All are associated with the **Kerosene** GCMS pattern. My graphical integration is unable to quantitate the total Kerosene and I recommend adding all these peaks together which results in a total Kerosene concentration = 7.5 ppm.

TIC 4: Tributyl Phosphate at 300 ppm

TICs 7 and 8: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TICs 9 and 10: Unknown

SAMPLE B00YC8 (Lab File ID: J070217)

TICs 1 - 6, and 8: All are associated with the **Kerosene** GCMS pattern. My graphical integration is unable to quantitate the total Kerosene and I recommend adding all these peaks together which results in a total Kerosene concentration = 4.9 ppm.

TIC 7: Hexachlorobutene at .3 ppm

TIC 12: Tributyl Phosphate at 200 ppm.

TICs 9, 12, 13, and 14: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TICs 11, 15, 17 to 21: Unknown

SAMPLE B00YC9 (Lab File ID: J070218)

TICS 1, 2 and 3 are all Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TIC 4: Remains to be an unknown compounds

TIC 5: Tributyl Phosphate at 6 ppm

TICs 6 and 7: All appear to be associated with Tributyl Phosphate as either an ageing component or an original impurity which is very similar to Tributyl Phosphate.

TIC 8: Unknown

SAMPLE BOOYDO (Lab File ID: J070219)

TICs 1 and 2 are Aldol Condensates and are probably reaction products of Acetone (a common laboratory contaminant). The EPA data review guidelines #R-582-4-5-01 state that these may be ignored.

TIC 3: Tributyl Phosphate at .3 ppm

TICs 4 and 5: unknown

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I hope this synopsis of your samples can aid you in your activities. If you have any questions, please feel free to call me.

Loren K. Thompson 7-30-91

Loren K. Thompson, Ph.D.
Principal Scientist
WHC-OSM (373-3448)

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APPENDIX F

RISK ASSESSMENT

Prepared by:
Risk Management Services
IT Corporation
Knoxville, Tennessee

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1.0 INTRODUCTION

This risk assessment was conducted to determine whether contaminants in the subsurface soils of the 618-9 burial ground pose a potential current or future threat to human health. Results of the assessment are used to make recommendations on further remediation of the site.

The document follows the standard format for a baseline risk assessment presented in Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (U.S. Environmental Protection Agency (EPA) (1989a). Other pertinent guidance documents used to prepare this assessment include (but are not limited to):

- Exposure Factors Handbook (EPA 1989b)
- Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA (EPA 1988)
- Guidance for Data Useability in Risk Assessment (EPA 1990a)
- Health Effects Assessment Summary Tables (HEAST), Annual FY 1991 (EPA 1991a)
- Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors" (EPA 1991b).

The outline of the risk assessment process is summarized in the following sections. Data from soil sampling were analyzed in order to select chemicals of potential concern. Relevant pathways of potential current and future exposure were determined. An exposure assessment was performed on selected representative chemicals of concern. Environmental fate and transport modeling was used to estimate the concentrations of chemicals in groundwater that might result from leaching of contaminants from the burial trench. The toxicity of the chemicals of concern was evaluated. Exposure and toxicity data were then used to quantitatively characterize risk.

2.0 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

The first stage of a risk assessment involves compiling data from sample analyses in a manner that allows systematic selection of site-related chemicals of concern. This process involves:

- Determining the frequency of detection, mean, standard deviation, and upper 95% concentration of each positively identified chemical
- Comparing site-related concentrations to background concentrations
- Comparing site-related concentrations to concentrations in blanks
- Evaluating historical data to determine if any potential chemicals of concern may have been missed during sampling.

2.1 Sources of Data

Data resulting from analysis of soil samples taken at the 618-9 burial ground were provided by Westinghouse Hanford Company. Data for blanks were also provided. Site-specific background data for some chemicals were obtained from the Remedial Investigation/Feasibility Study Work Plan for the 300-FF-5 Operable Unit, Hanford Site, Richland, Washington (U.S. Department of Energy (DOE) (1990), and regional background data for other chemicals were available in Chemical Analyses of Soils and Other Surficial Materials of the Conterminous United States (Boerngen and Shacklette, 1981).

2.2 Evaluation of Data

All chemicals for which there was at least one positive detection were evaluated further. Chemicals that could only be tentatively identified (TICs) were omitted from quantitative analysis. Tentative identifications included tributylphosphate, phosphoric acid, unknowns, and broad classes of compounds such as alkanes, cycloalkanes, hydrocarbons, and aromatic hydrocarbons. Historical evidence indicates that many of these TICs may be components of kerosene. Since kerosene is not generally considered to be a significant health hazard, these broad classes of TICs were not evaluated further. Tributylphosphate was not considered further since it was identified only once, and then only tentatively. Phosphoric acid was not evaluated as it is not typically considered to be very hazardous. Phosphoric acid/phosphates, chlorides, and sulfates are normal dietary components that are generally toxic only at very high concentrations. Hence, these chemicals were omitted from further evaluation.

2.2.1 Statistical Evaluation

For the chemicals still under evaluation, the frequency of detection, arithmetic mean, standard deviation, upper 95% concentration, and range of concentrations were determined. If a chemical was not detected in a particular sample, it was assumed to be present at one half the sample quantification limit unless the sample quantification limit was unreasonable (higher than the minimum contract lab required detection limit), in which case the sample was omitted from the sample population.

2.2.2 Comparison with Background Data

Site-specific background values were available for some chemicals (DOE 1990). Some of these values were randomly chosen for comparison with values from the U.S. Geological Survey's Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States (Shacklette and Boerngen, 1984) to provide greater certainty that the site-specific background values actually represent levels uncontaminated by the site. For cobalt and silver background soil data were taken from Boerngen and Shacklette (1981). The upper 95% concentration for each chemical was compared with the average background concentration. If the upper 95% value for a chemical was less than the mean background concentration, the chemical was omitted from further consideration (EPA 1989a). On the basis of comparison to background data, all of the metals (aluminum, barium, beryllium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, vanadium, and zinc) were omitted from further consideration.

2.2.3 Comparison with Blanks

Because contamination of samples with common laboratory chemicals is inevitable, EPA (1989a; 1990a) has developed guidance for determining if such chemicals are from the media sampled or are a result of contamination by sample collection and laboratory procedures. The guidance states that common laboratory chemicals found in a sample should be omitted from consideration as chemicals of concern if none of the positive detections for the samples exceed the maximum concentration in laboratory blanks by ten-fold. Similarly, according to EPA guidance (1989a; 1990a), data for other chemicals should be omitted unless the highest concentration exceeds by five-fold the concentration in the highest blank. Blank data were available for acetone, methylene chloride, di-n-butylphthalate, toluene, and several metals. Table 2-1 summarizes the blank data.

On the basis of comparison with the blank data, acetone, methylene chloride, di-n-butylphthalate, barium, manganese, and toluene were eliminated from further evaluation.

2.2.4 Evaluation of Historical Data

Historical evidence indicates that MIBK (hexone) might be present in the subsurface soil. However, analysis of soil samples indicates that no MIBK is present at the depths at which soil samples were obtained. EPA guidance (1989a) suggests that in such cases the chemical should be considered to be potentially present at the highest sample quantification limit.

Table 2-1. Evaluation of Laboratory Contaminant.

Chemical	Maximum Blank (mg/kg)	10 X Maximum Blank (mg/kg)	Maximum Sample Concentration[a] (mg/kg)	Exclude?
Common Contaminant				
Acetone	0.064 (low)[a]	0.64 (low)	0.28 (low)	YES
	2.5 (med)[a]	25 (med)	0.68 (med)	
Methylene Chloride	0,048 (low)[a]	0.48 (low)	0.24 (low)	YES
	1.2 (med)[a]	12 (med)	2.3 (med)	
Di-n-butylphthalate	0.64	6.4	6.2	YES

[a] Low and medium refer to differences in analytical methods (specifically, to differences in the size of soil sample analyzed and the dilution factor). The medium level method has a higher dilution factor with respect to the sample but equal potential after dilution for contamination. Hence, the amount of contamination in relation to the amount of sample is greater for the medium level method.

2.3 Summary of Chemicals of Potential Concern

Chemicals that were not eliminated on the basis of comparison with background and/or blank data include nitrates, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, chloroform, MIBK, phenanthrene, 1,1,2,2,-tetrachloroethane, trichloroethene, tetrachloroethene, hexachloroethane, and hexachlorobutadiene. These were identified as the chemicals of potential concern for the 618-9 burial ground. Table 2-2 summarizes the analytical sampling data and the process of selection of chemicals of concern.

Table 2-2. Evaluation of Chemicals of Potential Concern. (sheet 1 of 3)

Chemical	Frequency of detection[a]	Highest blank (mg/kg)	Average background concentration (mg/kg)	On-site concentrations in soil (mg/kg)			Chemical of concern?	Reason
				Range (Including Non-Detects at Detection Limit)	Arithmetic mean	Arithmetic upper 95%		
Inorganics								
Aluminum	32/32	181.4	9690	1400 - 4480	2779.94	3081.98	NO	Below background
Barium	32/32	24.4	93	21 - 88.1	51.3	56.9	NO	Below background; Max. conc. < 5 X highest blank
Beryllium	23/32	NA	0.4	<0.159 - 0.45	0.21	0.25	NO	Below background
Calcium	32/32	133.3	7010	2260 - 5710	3397.08	3648.13	NO	Below background
Chromium	1/32	NA	9.7	<0.42 - 0.47	0.27	0.29	NO	Below background
Cobalt	32/32	NA	17 (7-30) West WA	3.6 - 12.3	6.0	6.61	NO	Below Western WA. normal background
Copper	32/32	1.4	1.4	5.1 - 14.1	8.49	9.22	NO	Below background
Iron	32/32	755.1	27300	7920.2 - 20400	11038.66	11970.71	NO	Below background
Magnesium	32/32	57.4	6090	1150 - 4210	2239.12	2457.38	NO	Below background
Manganese	32/32	82.7	391	81.8 - 313	189.23	212.1	NO	Below background; max. conc. < 5 X highest blank
Nickel	32/32	NA	7.5	2.3 - 9.1	5.48	6.15	NO	Below background
Potassium	31/32	NA	1590	<176 - 1411.9	665.13	783.23	NO	Below background
Silver	19/32	NA	2.8 (0.7 - 5) US	<0.566 - 3.1	1.04	1.31	NO	Below typical US background
Sodium	32/32	26.5	287	67.4 - 201	109.98	121.66	NO	Below background
Vanadium	32/32	1.5	59.6	1.9 - 29.8	12.82	14.82	NO	Below background
Zinc	32/32	3	49.5	10.7 - 66.9	24.98	29.67	NO	Below background

Table 2-2. Evaluation of Chemicals of Potential Concern. (sheet 2 of 3)

Chemical	Frequency of detection[a]	Highest blank (mg/kg)	Average background concentration (mg/kg)	On-site concentrations in soil (mg/kg)			Chemical of concern?	Reason
				Range (Including Non-Detects at Detection Limit)	Arithmetic mean	Arithmetic upper 95%		
Nitrates	23/32	NA	0.6	<1.3 - 1670	130.94	265.71	YES	Above background; common in diet, but toxic potential is sufficient to warrant further consideration
Organics								
Acetone	30/30	2.5	NA	0.017 - 0.68	0.0777	0.126	NO	Common lab chemical; max. sample concentration < 10 X max. conc. in blank
Bis(2-ethylhexyl)phthalate	4/8	NA	ND	0.037 - 5.2	0.75	2.16	YES	Positive detect with no reason for exclusion
Di-n-butylphthalate	32/32	0.64	NA	0.051 - 6.2	2.31	2.94	NO	Max. sample concentration < 10 X max. conc. in blanks
Butylbenzylphthalate	9/13	NA	ND	0.038 - 2.7	0.732	1.26	YES	Positive detect with no reason for exclusion
Chloroform	2/18	NA	NA	<0.005 - 0.009	0.00306	.00388	YES	Positive detect with no reason for exclusion
Methylene Chloride	31/31	1.2	ND	0.019 - 2.3	0.162	0.322	NO	Common lab chemical; max. concentration in samples < 10 X Max. conc. in blanks

Table 2-2. Evaluation of Chemicals of Potential Concern. (sheet 3 of 3)

Chemical	Frequency of detection[a]	Highest blank (mg/kg)	Average background concentration (mg/kg)	On-site concentrations in soil (mg/kg)			Chemical of concern?	Reason
				Range (Including Non-Detects at Detection Limit)	Arithmetic mean	Arithmetic upper 95%		
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0/32	NA	NA	0.01 - 1.3[b]	0.138[b]	0.272[b]	YES[b]	Historical data indicates MIBK should be present.
Phenanthrene	1/5	NA	NA	0.24 - <0.33	0.18	0.217	YES	Positive detect with no reason for exclusion
1,1,2,2-Tetrachloroethane	6/20	NA	NA	0.001 - 0.11	0.0156	0.0294	YES	Positive detect with no reason for exclusion
Trichloroethene	1/16	NA	ND	0.002 - < 0.005	0.00247	0.00253	YES	Positive detect with no reason for exclusion
Tetrachloroethene	9/23	NA	ND	0.004 - 0.92	0.0719	0.156	YES	Positive detect with no reason for exclusion
Toluene	2/16	0.002	ND	0.001 - <0.005	0.00238	0.00257	NO	Max. conc. < 5 X highest blank
Tributylphosphate	TIC-1[c]	NA	NA	30	30	NA	NO	Only identified once, and then only tentatively
Hexachloroethane	6/10	NA	NA	0.11 - 17	2.3	5.81	YES	Positive detect with no reason for exclusion
Hexachlorobutadiene	7/11	NA	NA	0.12 - 0.76	0.295	0.295	YES	Positive detect with no reason for exclusion

[a] Non-detects were not considered when detection limits were unreasonably high (above contract lab requirements).
[b] Highest Sample Quantification Limit used for MIBK since no MIBK was detected in the samples, but historical information indicates the likelihood of MIBK contamination.
[c] Tributylphosphate was tentatively identified one time.
NA = Not Available ND = Not Detected

3.0 SELECTION OF REPRESENTATIVE CHEMICALS FOR RISK ASSESSMENT

A CERCLA-driven removal action is usually initiated to address an imminent hazard. Because of the desire to address removal actions in a timely manner, the EPA has generally required that the removal action risk assessment support focus on the major concerns at the site and not be as inclusive as a Remedial Investigation (RI) risk assessment. For this reason rather than conducting a quantitative exposure and risk assessment on all eleven chemicals of concern, a few representative chemicals have been chosen for quantitative assessment. The selection of representative chemicals was based on a toxicity/concentration screening in accordance with EPA guidance (EPA 1989a). This process determines which chemicals are likely to cause the highest risk. For carcinogens the oral slope factor (see section 5.0) is multiplied by the concentration in soil (upper 95%). For non-carcinogens the upper 95% concentration in soil is divided by the oral reference dose. The oral value is used since virtually all exposure was determined to be via the oral route. These products or quotients, referred to as risk factors, provide a basis for ranking carcinogens or non-carcinogens to determine which chemicals are likely to create the highest levels of risk. Table 3-1 shows the results of this process. Note that the units for the risk factors depend on the medium being screened, in this case soil. The absolute units do not matter since the risk factors are used as relative values in the screening process.

The representative chemicals were determined to be nitrates, hexachloroethane, hexachlorobutadiene, tetrachloroethene, and 1,1,2,2-tetrachloroethene. Bis(2-ethylhexyl)phthalate was not considered representative since it is a common lab contaminant. Further, it was only detected four times, three of which were at levels below the sample quantification limit. Hence, it was considered unlikely that bis(2-ethylhexyl)phthalate was a site-related contaminant.

Table 3-1. Toxicity/Concentration Screen to Determine Representative Chemicals.

Chemical	Concentration in soil (upper 95%)	Toxicity value (oral)[a]	Risk factor[b]
Carcinogens			
Bis(2-ethylhexyl)phthalate	2.16	0.014	3.02e-2
Chloroform	0.00388	6.1e-3	2.37e-5
1,1,2,2-Tetrachloroethane	0.0294	0.2	5.88e-3
Trichloroethene	0.00253	0.011	2.78e-5
Tetrachloroethene	0.156	0.051	7.96e-3
Hexachloroethane	5.81	0.014	8.13e-2
Hexachlorobutadiene	0.295	0.078	2.30e-2
Noncarcinogens			
Nitrates	265.71	1.6[c]	166.1
Bis(2-ethylhexyl)phthalate	2.16	0.02	108
Butylbenzylphthalate	1.26	0.2	6.3
Chloroform	0.00388	0.01	0.388
MIBK	1.3[d]	0.05	26
Phenanthrene	0.217	Data inadequate	NA
Tetrachloroethane	0.156	0.01	15.6
Hexachloroethane	5.81	0.001	5810
Hexachlorobutadiene	0.295	0.002	147.5

[a] Toxicity value are slope factors for carcinogens and reference doses for non-carcinogens, taken from EPA (1991a) unless otherwise indicated; oral value used since vast majority of exposure is via the oral route. Carcinogens and noncarcinogens are screened separately. Note that some chemicals exhibit both carcinogenic and chemical toxic effects.

[b] Score is tabulated in the following manner; for carcinogens - concentration x toxicity; for noncarcinogens - concentration/toxicity.

[c] EPA 1989a; Hazardous Substance Data Base, 1991

[d] Highest sample quantification limit (no positive detects, but historical evidence of MIBK's presence).

4.0 EXPOSURE ASSESSMENT

The exposure assessment is a quantitative estimation of daily exposure to chemicals of concern. An exposure assessment was performed for nitrates, hexachloroethane, hexachlorobutadiene, 1,1,2,2-tetrachloroethene, and tetrachloroethene, the chemicals expected to produce the highest levels of risk. The general procedure for conducting an exposure assessment is:

- Characterization of the exposure setting
- Identification of exposure pathways
- Determination of exposure point concentrations
- Quantification of exposure.

4.1 Physical Setting

The 618-9 burial trench is located in the southeastern portion of the Hanford Reservation, less than 1 mi west of the Columbia River. Surroundings are desert-like with sandy soils and little vegetation. The area can be accessed by a gravel road, however; trespassing would be difficult because of a 6-ft fence surrounding the site. Topographically, the land surface gradient is very flat.

4.2 Identification of Potential Pathways of Exposure

This section presents the identification of potential exposure pathways associated with the 618-9 Burial Ground. An exposure pathway consists of the following components:

- A source of contamination
- A mechanism of transporting contaminants through an environmental medium to a point of human contact
- A receptor at the location of the exposure
- A route of exposure (e.g. ingestion, inhalation).

Table 4-1 lists current and future exposure pathways that were identified as potential concerns at the site. Note that no current exposure pathways are assumed to exist mainly due to the subsurface nature of the soils. However, it is assumed that future exposure could occur through the groundwater if someone were to live and drill a well on site. Future exposure to the groundwater is assumed to occur through the following pathways:

- Direct ingestion of drinking water
- Indoor inhalation while showering and from general water use
- Dermal contact while bathing

- Ingestion of home-garden vegetables irrigated with groundwater
- Ingestion of beef and milk, contaminated by cattle ingesting water

Table 4-1. Potential Exposure Pathways Associated With 618-9 Burial Ground.

Receptor	Exposure Pathway	Included in Risk Assessment?/Reason
Current Land-Use[a]		
General Public (off-site)	direct exposures to contaminants in soil, groundwater or air	No. Current security control measures and isolation of site preclude access to the site by the public.
General Public (at river)	exposure to surface water; ingestion of fish in river	No. None of the 618-9 burial ground chemicals of concern have been detected in the well directly downgradient of the trench (DOE 1990).
On-property personnel (not associated with remediation activities)	inhalation of volatiles	No. Nonessential Hanford personnel do not visit this area. Also, the flux of vapor-phase contaminants would be diluted to below detection limit concentrations. Contaminated soils are 14 ft deep.
On-property personnel	direct contact with soil	No. Contaminated soils are 14 ft deep.
Trespasser scenario	direct contact with soil	No. A 6-ft fence surrounds the trench area; the nearest resident is over 2 mi to the south.
Future Land Use[b]		
On-site resident farmer	direct contact with soils: ingestion, dermal contact	No. Contaminants are in subsurface soils.
	inhalation of volatiles	No. Contaminants migrate and diffuse through the soil gases for approximately 14 ft. Concentrations would be low.
	exposure to groundwater via: -direct ingestion -dermal contact, washing, bathing -inhalation from home water use and during showering -irrigation of vegetables -livestock watering: beef, milk	Yes. Future resident may place a potable water well in the aquifer alongside of the trench area and use the water for household use, garden use and livestock watering.

[a] Current security control measures are in place. The nearest downgradient resident is over 2 mi south of the Hanford site.
[b] Assuming a resident farmer scenario.

4.3 Estimation of Exposure Point Concentration

The exposure point concentration is the concentration in the medium of interest to which an individual could potentially be exposed. All identified future potential exposures come from direct or indirect exposure to groundwater. Therefore, exposure points concentration had to be estimated in groundwater. The upper 95% confidence limit of the soil sample data was used in modeling the exposure point concentration (EPA 1989a).

4.3.1 Model Description and Parameters

The model entitled "Seasonal Cycles of Water, Sediment, and Pollutants in Soil Environments (SESOIL; EPA 1986a) was used to predict the behavior of the chemicals of concern in the unsaturated soil zone. The model was designed to incorporate contaminant inputs, climatic data, chemical properties, and soil parameters to estimate contaminant behavior in soil layers above the groundwater table. The upper 95 percent confidence interval about the mean soil concentration was used to calculate the initial input of contaminant to the soil. The contaminant concentration was introduced into the first month of year 1 to the second soil layer in SESOIL, at a depth of 9 to 10 ft.

The AT123D model (EPA 1986a) was used to estimate groundwater concentrations using output from SESOIL.

Site-specific input parameters for both models are listed in Table 4-2. Monthly climatic data are from the SESOIL data base for Yakima, Washington and NOAA (1983) and are listed in Table 4-3. Table 4-4 presents the chemical-specific parameters used in the SESOIL model.

Output from the AT123D model was used to estimate the groundwater exposure point concentrations. The value was selected from the 3-dimensional output at a point directly below the source, just below the groundwater table (x, y, and z distances in the aquifer equal to zero). This represents the point of maximum concentration in the groundwater, with no lateral transport and minimal vertical dispersion within the aquifer. The concentration was also selected from the year with the maximum concentration.

4.3.2 Uncertainties

Uncertainties in estimating exposure point concentrations from the SESOIL and AT123D models include:

- The variability of weather at the site from year to year is not reflected by the historical average values used in the climatic input data
- Uncertainty is introduced from use of some default parameters (such as the SESOIL data for generic sand) when site-specific data are not available
- Use of chemical-specific parameters such as Henry's Law constant and Koc and hydrogeologic parameters such as hydraulic gradient and hydraulic conductivity that are inherently variable, introduces uncertainty
- Uncertainties from sample analysis and calculation of the upper 95 percent levels for soil contaminants are incorporated into the model results
- Characterization of soil layers is simplified in the model input and does not reflect small-scale variations in site conditions
- The selection of a groundwater concentration from the AT123D output introduces uncertainty because the concentration varies with time and distance in the aquifer

Whenever possible, parameters and concentrations were selected with a conservative bias This was done so that the error tends to overestimate exposure point concentrations instead of underestimate them.

Table 4-2. Site-Specific Input Parameters.

Soil Input Parameters [a]			
Soil density (g/cm^3):	1.32		
Intrinsic permeability (cm^2):	.100E-06		
Disconnectedness index :	3.50		
Porosity :	.250		
Organic carbon content (%):	0.01		
Clay content (%):	.000		
Cation exchange capacity (milli eq./100 dry soil):	.000		
Freundlich exponent :	1.00		
Application Input Parameters			
Number of soil layers:	3		
Years to be simulated:	30 - 99		
Area (cm^2):	0.966E+06		
Application area latitude (deg.):	46.6		
Spill (1) or steady application (0):	1		
	Layer 1	Layer 2	Layer 3
Depths (cm):	270	30.	910
Number of sublayers/layer	1	1	6
pH (cm):	7.0	7.0	7.0
Intrinsic permeabilities (cm^2):	0.00	0.00	0.00
Kdel ratios to layer 1:	1.0	1.0	
Kdes ratios to layer 1:	1.0	1.0	
Oc ratios to layer 1:	1.0	1.0	
Cec ratios to layer 1:	1.0	1.0	
Frn ratios to layer 1:	1.0	1.0	
Ads ratios to layer 1:	1.0	1.0	
Groundwater Input Parameters [b]			
Aquifer depth (meters) :	24.38		
Aquifer width (meters) :	infinite width		
Porosity :	0.30		
Hydraulic conductivity (m/hr) :	6.35		
Hydraulic gradient :	0.0017		

[a] From SESOIL data base for generic sand.
[b] All other parameters not listed were calculated by AT123D.

Table 4-3. Climate Data.

Climatic Input Parameters[a]

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Temp. (Deg c)	10.940	4.220	0.380	-1.610	2.550	6.050	10.440	15.000	18.720	22.610	21.610	17.500
Cloud cover (frac.)	0.600	0.800	0.800	0.800	0.800	0.700	0.650	0.600	0.600	0.300	0.400	0.400
Rel. Hum.(Frac.)	0.650	0.800	0.800	0.800	0.800	0.600	0.550	0.500	0.500	0.400	0.400	0.500
Albedo	0.140	0.150	0.190	0.230	0.160	0.160	0.140	0.140	0.140	0.140	0.140	0.140
Evapot. (cm/day)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Precipitation (cm) [b]	2.440	3.230	3.760	3.200	2.490	2.180	1.700	1.850	2.470	0.510	0.530	1.120
Mean Time of rain(days)	0.290	0.360	0.450	0.450	0.390	0.320	0.220	0.250	0.270	0.100	0.150	0.220
Mean Storm no.	1.740	3.220	4.020	3.850	2.620	2.170	1.400	1.340	1.620	0.450	1.110	1.130
Mean Season (days)	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40	30.40

[a] From SESOIL database for Yakima, Washington WSO AP
[b] From NOAA, 1983 Climatic Atlas of the United States for Hanford area

Table 4-4. Chemical-Specific Input Parameters.

Parameter	Hexachloro-butadiene	Tetrachloro-ethylene	1,1,2,2-Tetra-chloroethane	Hexachloroethane	Nitrate
Solubility (ug/ml):	3.20	150	.290E+04 [a]	50.0 [a]	.100E+07 [b]
Diffusion coefficient in air (cm^2/sec):	0.0589	.746E-01	.746E-01 [c]	.640E-01 [d]	.746E-01 [d]
Henrys law constant (m^3-atm/mole):	8.15E-03	.204E-02	.381E-03 [a]	.249E-02 [a]	0
Adsorption coefficient on organic carbon (Koc):	9490	468	118 [a]	.200E+05 [a]	0
Adsorption coefficient on soil (k):					
Molecular weight (g/mol):	261	166	168 [a]	237 [a]	62 [b]
Valence :	0	0	0	0	1
Neutral hydrolysis constant (/day):	0	0	0	0	0
Base hydrolysis constant (l/mol-day):	0	0	0	0	0
Acid hydrolysis constant (l/mol-day):	0	0	0	0	0
Degradation rate in moisture (/day):	0	0	0	0	0
Degradation rate on soil (/day):	0.00385 [e]	0	0	0.00385[e]	0
Ligand-pollutant stability constant :	0	0	0	0	0
No. Moles ligand/mole pollutant :	0	0	0	0	0
Ligand molecular weight (g/mol):	0	0	0	0	0
Concentration added to soil layer 2 (ug/cm):	11.9	6.29	1.18	2.34E+02	1.07E+04

[a](EPA, 1986b).
[b]Nitrate is infinitely soluble in water (Summers 1975)
[c]Used coefficient for tetrachloroethylene from SESOIL data base because of similar molecular weights
[d]Used coefficient for benzo(a)anthracene from SESOIL data base because of similar molecular weights
[e]Handbook of Environmental Degradation Rates (Howard et al., 1991)
Note: If not referenced, parameter is a calculated or default value from SESOIL.

Table 4-5. Results of SESOIL and AT123D Models.

Chemical	Concentration in groundwater (mg/l)	Time of peak concentration (years)[a]
Tetrachloroethylene	6.48×10^{-6} (mg/L)	4
1,1,2,2-Tetrachloroethane	3.21×10^{-6}	2
Hexachloroethane	NA[b]	>99
Hexachlorobutadiene	8.03×10^{-16}	56
Nitrate	0.0836	1

[a]selected from 3-dimensional AT123D model output at point x,y,z = 0
[b]did not reach the groundwater after 99 yr

4.4 Quantification of Exposure

Once exposure point concentrations are determined, estimates must be made of the amount of contaminant to which a receptor potentially may be exposed. The EPA (1989a) has determined that assumptions and parameters that describe a "reasonable maximum exposure" (RME) should be used to estimate contaminant intake.

Conservative assumptions have been built into the RME scenario. Guidelines from EPA, Region 10 (EPA Region X, 1990a) were used when available. It was assumed that the RME receptor would reside in the area of maximum contamination for 75 yr and would have a well at the point that leachate from the burial ground enters the aquifer. It was assumed that this person would use this well water for household use, for drinking water, to irrigate a garden, and to water beef and dairy cattle. Even though the concentration in groundwater will change with time, it was assumed that the highest estimated concentration in well water over a 75-yr period is the concentration to which the receptor would be exposed.

The basic form of the exposure model for all pathways is as follows:

$$Exposure(mg/kg/day) = \frac{CxIRxBxEFxED}{ATxBW}$$

where:

C = concentration of the chemical in the exposure media (i.e. mg/kg in beef, milk, or vegetables; mg/l in water; mg/m^3 in air); note: Concentrations in beef, milk, vegetables, and air are estimated from the concentration in groundwater; see appendix A for details

IR = rate of contact (i.e. ingestion rate of beef, milk, or vegetables (kg/day), the ingestion rate of water (l/day), or the inhalation rate of air (m^3/day))
B = bioavailability factor or the percent of intake that is absorbed through the skin, lungs, or gastrointestinal tract
EF = exposure frequency (days/year of exposure)
ED = exposure duration (years of exposure)
BW = adult body weight (kg)
AT = averaging time (days); this the total period of exposure over which actual exposure is to be averaged (27,375 days)

Pathway-specific exposure models and parameters are given in Appendix A. The appendix also provides details on the estimation of the concentrations in indirect exposure media from the concentration in groundwater. The contribution to exposure from each pathway and route is given in Table 4-6. Note that the inhalation pathway was not significant compared to the ingestion pathway. The chemical-specific exposure estimates for each pathway are also given in Table 4-6. Exposure was not estimated for hexachloroethane since modeling indicated that no leachate is expected to reach the groundwater in the next 100 yr. The biodegradation half-life in soil for hexachloroethane is estimated to be four weeks to six months (Howard et al. 1991). Hence, little hexachloroethane is likely to remain in 100 yr, which is over 200 half-lives. Exposure was also not estimated for hexachlorobutadiene since fate and transport modeling results indicate that peak concentrations in the groundwater will only reach 10^{-16} levels.

Table 4-6. Estimated Exposures.

Chemical	Pathway/Route	Concentration (mg/l)	Exposure Percent	Exposure mg/kg/day
Nitrates	Drinking Water	8.36×10^{-2}	100	2.39×10^{-3}
1,1,2,2-Tetrachloroethane	Drinking Water	3.21×10^{-6}	50.7	9.17×10^{-8}
	Beef Ingestion		0.0006	1.06×10^{-12}
	Milk Ingestion		0.0009	1.61×10^{-12}
	Vegetable Ingestion		44.4	8.03×10^{-8}
	Dermal-Bathing		0.0035	6.26×10^{-11}
	Inhalation-Showering		1.5	2.56×10^{-9}
	Inhalation-Other Water Use		3.6	6.13×10^{-9}
	Ingestion		95.2	1.72×10^{-7}
	Inhalation		4.8	8.69×10^{-9}
	Dermal		0.0035	6.26×10^{-11}
	Total		100	1.81×10^{-7}
Tetrachloroethene	Drinking Water	6.48×10^{-6}	48.9	1.85×10^{-7}
	Beef Ingestion		0.0009	3.43×10^{-12}
	Milk Ingestion		0.0014	5.27×10^{-12}
	Vegetable Ingestion		34.4	1.30×10^{-7}
	Dermal-Bathing		0.033	1.26×10^{-10}
	Inhalation-Showering		4.6	1.74×10^{-8}
	Inhalation-Other Water Use		12.1	4.57×10^{-8}
	Ingestion		83.3	3.15×10^{-7}
	Inhalation		16.7	6.31×10^{-8}
	Dermal		0.033	1.26×10^{-10}
	Total		100	3.78×10^{-7}

5.0 TOXICITY ASSESSMENT

In order to estimate risk from exposure, information on chemical-specific toxicity is required. The EPA provides information on the toxicity of chemicals in two forms (EPA 1991a; EPA 1991c): for carcinogens a slope factor (SF) is used to describe the dose-response relationship; for noncarcinogenic toxicants a threshold dose, or Reference Dose (RfD), is used to describe the dose above which adverse health effects may be observed. For carcinogens the endpoint of concern is always cancer. For noncarcinogens the toxic endpoint (e.g. kidney effects) may vary among chemicals. Tables 5-1 and 5-2 summarize the toxicity information for the chemicals of concern at the site. This information, which was used to help select the five dominant chemicals of concern, is also used to estimate risk.

When inhalation SFs and RfDs were not available, oral values were used to estimate risk via inhalation.

Table 5-1. Toxicity Summary for Carcinogenic Chemicals.

Chemical	Slope Factor, $(mg/kg/day)^{-1}$	Weight of Evidence Classification	Type of Cancer
Oral			
Bis(2-ethylhexyl)phthalate	1.4×10^{-2}	B2	Liver
Chloroform	6.1×10^{-3}	B2	Kidney
1,1,2,2-Tetrachloroethane	2.0×10^{-1}	C	Liver
Trichloroethene	1.1×10^{-2}	B2	Liver
Tetrachloroethene	5.1×10^{-2}	B2	Liver
Hexachlorobutadiene	7.8×10^{-2}	C	Kidney
Hexachloroethane	1.4×10^{-2}	C	Liver
Inhalation			
Bis(2-ethylhexyl)phthalate	None given		
Chloroform	8.1×10^{-2}	B2	Liver
1,1,2,2-Tetrachloroethane	2.0×10^{-1}	C	Based on Oral Study
Trichloroethene	1.7×10^{-2}	B2	Lung
Tetrachloroethene	1.8×10^{-6}	B2	Liver, Leukemia
Hexachlorobutadiene	7.8×10^{-2}	C	Based on Oral Study
Hexachloroethane	1.4×10^{-2}	C	Based on Oral Study

Table 5-2. Toxicity Summary for Noncarcinogenic Chemicals.

Chemical	Chronic RfD (mg/kg/day)	Critical Effect	Uncertainty factor
Oral			
Nitrates	1.60		
Bis(2-ethylhexyl)phthalate	0.02	Increased liver weight	1,000
Butylbenzylphthalate	0.20	Liver, kidney, testes	1,000
Chloroform	0.01	Liver lesions	1,000
MIBK	0.05	Liver and kidney effects	1,000
Phenanthrene	Quantitative data not available		
Tetrachloroethene	0.01	Hepatotoxicity	1,000
Hexachloroethane	0.001	Kidney degeneration	1,000
Hexachlorobutadiene	0.002	Kidney toxicity	100
Inhalation			
MIBK	0.02	Liver and kidney effects	1,000

6.0 RISK ASSESSMENT

Once exposure has been quantified and quantitative toxicity data has been gathered, it is possible to estimate risk. Estimation of risk involves combining data on exposure and toxicity.

The excess risk associated with a carcinogen is the product of estimated exposure to a carcinogen and the chemical-specific, route-specific slope factor.

$$ILCR = SF \times EDI$$

where:

ILCR = incremental lifetime cancer risk (unitless)
SF = slope factor $(mg/kg/day)^{-1}$
EDI = estimated daily intake (mg/kg/day)

The value of SF is route specific, through ingestion or inhalation. Oral values were substituted for the dermal route since information on toxicity via dermal exposure is quite limited. When inhalation values were not available, oral values were used for inhalation exposures. Table 6-1 summarizes risks associated with each chemical. Since no current exposure pathways exist, the risks reported in Table 6-1 are for the future exposure scenario. These risks are estimates of risk expected if all of the conditions of the exposure scenario are met. Hence, actual risk is likely to be much lower. The total cancer risk for the site is the combined effects of all carcinogens. There are seven carcinogens among the chemicals of concern. Since it is likely that the chemicals evaluated are the chemicals producing the greatest risk, it is also likely that total risk from all seven carcinogens will not exceed 2.5×10^{-7}, or seven times the risk of 1,1,2,2-tetrachloroethane. The risk from each carcinogen evaluated, as well as the total risk expected from all carcinogens, are well under the 1×10^{-6} to 1×10^{-4} risk range that is generally considered acceptable by EPA (EPA 1990b).

Noncarcinogenic effects of chemicals are quantified as hazard indices. A hazard index is the ratio of the estimated daily intake to the RfD:

$$HI = EDI/RfD$$

where:

HI = hazard index (unitless)
EDI = estimated daily intake (mg/kg/day)
RfD = reference dose (mg/kg/day)

In addition, the sums of all HIs is determined to insure that exposures from all pathways and all chemicals are acceptable, where,

$$HQ = HI_1 + HI_2 + HI_3 + \ldots$$

HQ = hazard quotient

HIs are given in Table 6-1 for the chemicals evaluated. A hazard index less than one is considered to be safe. The hazard quotient (HQ) for the sum of all toxic effects, was also less than one. Since the chemicals evaluated were selected on the basis of their likelihood of producing higher risk levels, it can be assumed that none of the chemicals of concern appear to represent any future unacceptable noncarcinogenic exposure or unacceptable carcinogenic risk.

Table 6-1. Risk Estimates.

Chemical	Pathway/Route	Hazard Index	Cancer Risk
Nitrates	Drinking Water	0.0015	
	TOTAL	0.0015	
1,1,2,2-Tetrachloroethane			
	Drinking Water		1.83×10^{-8}
	Beef Ingestion		2.12×10^{-13}
	Milk Ingestion		3.22×10^{-13}
	Vegetable Ingestion		1.61×10^{-8}
	Dermal-Bathing		1.25×10^{-11}
	Inhalation-Showering		5.11×10^{-10}
	Inhalation-Other Household Water Use		1.23×10^{-9}
	Total by Route		
	Ingestion		3.44×10^{-8}
	Inhalation		1.74×10^{-9}
	Dermal		1.25×10^{-11}
	TOTAL		3.62×10^{-8}
Tetrachloroethene			
	Drinking Water	0.000019	9.44×10^{-9}
	Beef Ingestion	3.43×10^{-10}	1.75×10^{-13}
	Milk Ingestion	5.27×10^{-10}	2.69×10^{-13}
	Vegetable Ingestion	0.000013	6.62×10^{-9}
	Dermal-Bathing	1.26×10^{-8}	6.43×10^{-12}
	Inhalation-Showering	0.0000017	3.17×10^{-14}
	Inhalation-Other Household Water Use	0.0000046	8.32×10^{-14}
	Total by Route		
	Ingestion	0.000032	1.61×10^{-8}
	Inhalation	0.0000063	1.15×10^{-13}
	Dermal	1.26×10^{-8}	6.43×10^{-12}
	TOTAL	0.000038	1.61×10^{-8}

[a] The Hazard Index is the ratio of the estimated intake of a noncarcinogen over the reference dose.
[b] The cancer risk is the probability of contracting cancer over a lifetime from exposure to the hazardous agent.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the risk assessment process, it appears that representative chemicals detected in the subsurface soils of the 618-9 Burial Trench pose a potential future risk of about 10^{-7}, and do not pose a threat to human health or the environment.

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ATTACHMENT 1: EXPOSURE ASSESSMENT

The models used for estimating reasonable maximum exposures (RME) through each pathway are described below. In addition, a brief description of the rationale for the assumptions and exposure parameters used is given. The concentration of each chemical in water is given below:

Chemical	Concentration in Water
Nitrates	8.36×10^{-2}
1,1,2,2-Tetrachloroethane	3.21×10^{-6}
Tetrachloroethene	6.48×10^{-6}

Note that only the drinking water exposure pathway is applicable to nitrates.

Exhibit 1.0 Inhalation Exposure During Showering and as a Result of Household Water Use

Potential exposures through inhalation of volatiles released during showering and other household water use were evaluated separately for the hypothetical RME receptor defined by the exposure scenario.

The model used for estimating inhalation exposure due to showering is shown below: (Murphy, 1987):

$$I_S = \frac{[(1000*N_S*T_S*IR*C_W*F)/(A*V)] * \{1+[1/(a*T_S)][e^{-a*Ts}-1]\} * \{1-e^{-[(.93*1.48 \times 10\text{^}-3/H)\text{^}-1]}\}}{BW}$$

where:

I_S	=	estimated inhalation exposure during showering (mg/kg/day).
N_S	=	average number of showers per day
T_S	=	average length of shower (hrs/shower)
IR	=	average inhalation rate (m^3/hr)
C_W	=	concentration in water (mg/l)
F	=	shower water flow rate (m^3/hr)
A	=	air exchange rate between shower and rest of house (hrs^{-1})
V	=	volume of shower or bathroom (m^3)
H	=	Henry's Law Constant (atm*m^3/mol)(chemical-specific)
BW	=	average adult body weight (kg)

Assumptions used for these parameters are described below:

The number of showers per day was estimated to be 0.86 or 6 showers/week (EPA, 1990a). The length of a shower was estimated to be 12 minutes or 0.2 hrs (EPA, 1989). The average inhalation rate was assumed to be 20 m3/day or 0.83 m3/hr. The concentration in groundwater resulting from lenching from soil was estimated by modeling. A shower water flow rate of 0.48 m3/hr was used. The air exchange rate between the shower and the rest of the house was assumed to be 12 hrs^{-1}. The volume of the shower was assumed to be 12 m^3. Chemical-specific Henry's law constants (atm * m^3/mol; EPA, 1986) were as follows:

- tetrachloroethene H = 2.59×10^{-2}
- 1,1,2,2,-tetrachloroethane H = 3.81×10^{-4}

The average adult body weight of 70 kg (EPA, 1990a) was used.

The model for estimating exposure via inhalation of volatiles released during non-showering household water use (Murphy, 1987) is as follows:

$$I_h = \frac{\{[(T_h)(I)(C_w)(Q_w)(M)]/(Q_a)\}\{1-e^{-\{[1.26 + (2x10\text{^}-3)/H]\text{^}-1\}}\}}{BW}$$

where,

I_h	=	estimated inhalation exposure from household water use (mg/kg/day)
T_h	=	time spent at home inside (hrs/day)
I	=	inhalation rate (m^3/hr)
C_w	=	concentration in water (mg/l)
Q_w	=	quantity of water used inside daily (l/day)
M	=	mixing factor (unitless)
Q_a	=	volume air exchange rate for home (m3/day)
H	=	Henry's Law Constant (atm*m3/mol)
BW	=	average Adult Body Weight

Assumptions made for these exposure parameters are as follows: The time spent inside was estimated to be 20 hrs/day (EPA, 1990a). An inhalation rate of 20 m3/day or 0.83 m3/hr was used. The concentration in groundwater resulting from leaching from soil was estimated by modeling. The quantity of water used daily in the house was estimated to be8700 m^3/day. The quantity of air exchange between the house and outside was assumed to be 980 L/day. A mixing factor of 0.5 was

The number of showers per day was estimated to be 0.86 or 6 showers/week (EPA, 1990a). The length of a shower was estimated to be 12 minutes or 0.2 hrs (EPA, 1989). The average inhalation rate was assumed to be 20 m3/day or 0.83 m3/hr. The concentration in groundwater resulting from lenching from soil was estimated by modeling. A shower water flow rate of 0.48 m3/hr was used. The air exchange rate between the shower and the rest of the house was assumed to be 12 hrs^{-1}. The volume of the shower was assumed to be 12 m^3. Chemical-specific Henry's law constants (atm * m^3/mol; EPA, 1986) were as follows:

- tetrachloroethene H = 2.59×10^{-2}
- 1,1,2,2,-tetrachloroethane H = 3.81×10^{-4}

The average adult body weight of 70 kg (EPA, 1990a) was used.

The model for estimating exposure via inhalation of volatiles released during non-showering household water use (Murphy, 1987) is as follows:

$$I_h = \frac{\{[(T_h)(I)(C_w)(Q_w)(M)]/(Q_a)\}\{1-e^{-\{[1.26 + (2x10\text{^}-3)/H]\text{^}-1\}}\}}{BW}$$

where,

I_h	=	estimated inhalation exposure from household water use (mg/kg/day)
T_h	=	time spent at home inside (hrs/day)
I	=	inhalation rate (m^3/hr)
C_w	=	concentration in water (mg/l)
Q_w	=	quantity of water used inside daily (l/day)
M	=	mixing factor (unitless)
Q_a	=	volume air exchange rate for home (m3/day)
H	=	Henry's Law Constant (atm*m3/mol)
BW	=	average Adult Body Weight

Assumptions made for these exposure parameters are as follows: The time spent inside was estimated to be 20 hrs/day (EPA, 1990a). An inhalation rate of 20 m3/day or 0.83 m3/hr was used. The concentration in groundwater resulting from leaching from soil was estimated by modeling. The quantity of water used daily in the house was estimated to be8700 m^3/day. The quantity of air exchange between the house and outside was assumed to be 980 L/day. A mixing factor of 0.5 was

Exhibit 3.0 Beef Ingestion Pathway

$$I_b = \frac{(C_b)(IR_b)(B_b)(DF_b)(EF_b)(ED_b)}{(BW)(AT)}$$

where:

I_b	=	estimated ingestion exposure from beef (mg/kg/day).
C_b	=	concentration of constituent in beef (mg/kg).
IR_b	=	ingestion rate of beef (kg/day).
B_b	=	bioavailability factor for beef (unitless)
DF_b	=	diet fraction for beef (unitless)
EF_b	=	exposure frequency for beef (days/yr).
ED_b	=	exposure duration for beef (yrs)
BW	=	average body weight of exposed individuals (kg).
AT	=	averaging time (days)

The values used for these parameters are discussed below:

- Concentration in Beef
  - The concentration of each chemical in beef was estimated from the concentration in water, beef cattle water ingestion rates, and chemical-specific ingestion to beef transfer factors. Beef cattle ingest 50 liters of water daily (NRC, 1977). The beef transfer factors (days/kg; Travis and Arms, 1988; HSDB, 1991) for the chemicals evaluated are as follows:
    - for tetrachloroethene BTF = 1.0×10^{-5}
    - for 1,1,2,2-tetrachloroethane BTF = 6.17×10^{-6}
- Ingestion Rate of Beef
  - A beef ingestion rate of 0.075 kg/day was assumed (EPA, 1991)
- Bioavailability
  - A bioavailability of one was assumed.
- Diet Fraction
  - A diet fraction of one was used since a 0.75 diet fraction had already been used in the calculation of the beef ingestion rate.
- Exposure Frequency
  - It was assumed that beef was consumed daily.
- Exposure Duration
  - A 75-yr exposure duration was assumed (EPA, 1990a).
- Body Weight
  - The average body weight for adults of 70 kg was used (EPA, 1990a).
- Averaging Time
  - Exposure was averaged over 27,375 days or 75 yr (EPA, 1990a).

Exhibit 4.0 Milk Ingestion Pathway

$$I_m = \frac{(C_m)(IR_m)(B_m)(DF_m)(EF_m)(ED_m)}{(BW)(AT)}$$

Where:

I_m	=	estimated ingestion exposure from milk (mg/kg/day).
C_m	=	concentration of constituent in milk (mg/kg).
IR_m	=	ingestion rate of milk (kg/day).
B_m	=	bioavailability factor for milk (unitless)
DF_m	=	diet fraction for milk (unitless)
EF_m	=	exposure frequency for milk (days/yr).
ED_m	=	exposure duration for milk (yrs)
BW	=	average body weight of exposed individuals (kg).
AT	=	averaging time (days)

The values of these parameters are discussed below:

- Concentration in Milk
  - The concentration in milk was estimated from the concentration in water, the water ingestion rate of dairy cattle, and chemical-specific ingestion to milk transfer factors. Dairy cattle ingest 60 liters of water daily (NRC, 1977) The milk transfer factors for the chemicals evaluated are (Travis and Arms; HSDB, 1991):

    tetrachloroethene = 3.16×10^{-6}
    1,1,2,2-tetrachloroethane = 1.95×10^{-6}

- Ingestion Rate of Milk
  - A milk ingestion rate of 0.3 kg/day was used (EPA, 1991).
- Bioavailability
  - A bioavailability of one was assumed.
- Diet Fraction
  - A diet fraction of one was used. A 0.75 diet fraction was already incorporated into the ingestion rate.
- Exposure Frequency
  - It was assumed that milk was consumed daily.
- Exposure Duration
  - A 75-yr exposure duration was assumed (EPA, 1990a).
- Body Weight
  - The average body weight for adults of 70 kg was used (EPA, 1990a).
- Averaging Time
  - Exposure was averaged over 27,375 days or 75 yr (EPA, 1990a).

Exhibit 5.0 Vegetable Ingestion Pathway

$$I_v = \frac{(C_v)(IR_v)(B_v)(DF_v)(EF_v)(ED_v)}{(BW)(AT)}$$

where:

I_v	=	estimated ingestion exposure from vegetables (mg/kg/day).
C_v	=	concentration of constituent in vegetables (mg/kg).
IR_v	=	ingestion rate of vegetables (kg/day).
B_v	=	bioavailability factor for vegetables (unitless)
DF_v	=	diet fraction for vegetables (unitless)
EF_v	=	exposure frequency for vegetables (days/yr).
ED_v	=	exposure duration for vegetables (yrs)
BW	=	average body weight of exposed individuals (kg).
AT	=	averaging time (days)

The values used for these parameters are discussed below:

- Concentration in Vegetables
  - It was assumed that leafy vegetables would be grown. Contamination may result through both direct deposition of irrigation water onto the edible portion of the plant and uptake of the water by the roots from the soil. It was assumed that vegetables will be eaten raw and unwashed. The following model was used to estimate potential concentrations of chemicals in leafy vegetables due to deposition of irrigation wateronto the soil and the exposed portions of plants:

$$C_v = C_w * I_r * \{[F_r * (1-e^{-kt})/(K*Y)] + [F_i * B_i * T_s/D_s]\}$$

where:

C_v	=	concentration in vegetables (mg/kg)
C_w	=	concentration in water (mg/L) (from modeling; given previously)
I_r	=	annual irrigation rate = 0.097 $l/m^2/hr$ (Baes et al., 1984)
F_r	=	fraction of irrigation water retained on plant surface (unitless) = 0.25 (NRC, 1977).
K	=	removal rate constant from weathering = 0.0021 hrs^{-1}
t	=	length of time plant is exposed = 1440 hrs (NRC, 1977).
Y	=	agricultural productivity yield = 1.0 kg/m^2 (Baes et al., 1984).
F_i	=	fraction of year that irrigation occurs (unitless) = 0.58 (Baes et al. 1984)
B_i	=	chemical specific root uptake factor -- transfer to vegetative portion of plant.
T_s	=	time soil is exposed to irrigation = 131000 hrs (NRC, 1977)
D_s	=	effective soil surface density = 240 kg/m^2 (NRC, 1977)

· Concentration in vegetation	- The concentration in vegetation was estimated from the concentration in water and vegetable transfer factors (Travis and Arms, 1988): ·1,1,2,2-tetrachloroethane = 1.609 ·tetrachloroethene = 0.057
· Ingestion Rate of Vegetables	- A vegetable ingestion rate of 0.029 kg/day was assumed (EPA, 1990a; Baes et al., 1984).
· Bioavailability	- A bioavailability of one was assumed..
· Diet Fraction	- A diet fraction of one was used.
· Exposure Frequency	- It was assumed that vegetables were consumed daily (EPA, 1990a).
· Exposure Duration	- A 75-yr exposure duration was assumed (EPA, 1990a).
· Body Weight	- The average body weight for adults of 70 kg was used (EPA, 1990a).
· Averaging Time	- Exposure was averaged over 27,375 days or 75 yr (EPA, 1990a).

Exhibit 6.0 Dermal Exposure While Bathing

It has been assumed that dermal exposure while showering is negligible. However, dermal exposure while bathing is a realistic exposure pathway. Dermal exposure was estimated as follows (EPA, 1990ab):

$$I_d = \frac{C_w * S_a * P_c * ET * EF * ED * CF}{BW * AT}$$

where:

I_d	=	dermal exposure while bathing mg/kg/day
C_w	=	concentration in water (mg/l) (from modeling)
S_a	=	skin surface area exposed (cm2)
P_c	=	chemical-specific dermal permeability constant (cm/hr)
ET	=	exposure time (hrs/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
CF	=	conversion factor form liters to 1000 cm3

BW = body weight (adult average; kg)
AT = averaging time (days)

Assumptions regarding parameters are given below:

- Concentration in water - The concentration in water was estimated from modeling and was given previously.
- Skin Surface Area Exposed - It was assumed that 18150 cm^2 of skin was available for contact with water while bating (EPA, 1989b)
- Dermal Permeability Constants - Chemical-Specific permeability constants were not available; therefore, the permeability constant for water of 8×10^{-4} was used as recommended in (EPA, 1988)
- Exposure Time - Exposure was assumed to occur 0.33 hrs/day (19.8 minute bath).
- Exposure Frequency - It was assumed that a person takes two baths per week, or 104 baths per year.
- Exposure Duration - A 75-yr exposure duration was assumed (EPA 1990a).
- Body Weight - The average adult body weight of 70 kg was used (EPA, 1990a).
- Averaging Time - Exposure was averaged over 27,375 days or 75 yr (EPA 1991a).

Exhibit 7.0 References

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